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Kidney Tumors

Classification, Review of Symptoms, Methods of Diagnosis, Therapy, and End-Results[1]

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NEOPLASMS ARISING in the kidney cortex may not cause hematuria until they break into the renal pelvis; they are not apt to produce pain until they invade the capsule; patients seldom notice the kidney mass themselves, and as a result the tumor has, in most instances, grown to large proportions before recognition. These so-called "nephromata" tend to erode venous channels and thus metastasize widely. By the time the lesion is recognized the tumor is large, it has often metastasized, and as a result the prognosis is most unfavorable.

CLASSIFICATION

According to Boyd (1*a*), "there is no more perplexing chapter in the whole of pathology than that which deals with tumors of the kidney." The influence of Grawitz (2) is still felt, in that all cortical tumors except the embryoma are apt to be roughly construed as hypernephroma. On the other hand, there are those who deny the existence of a true hypernephroma, *i.e.*, a tumor arising from misplaced islands of adrenal tissue, as Carson (3), Judd and Hand (4). These writers state that hypernephroma should be considered as a true renal carcinoma. Arguments against the adrenal origin of this tumor have been listed as follows:

(*a*) No epinephrin has been synthesized from these growths.—Greer and Wells (5), Brooks (6).

(*b*) Double-refracting fat present in hypernephroma is present, also, in the protoplasm of renal epithelium and carcinoma.—Löhlein (7).

(*c*) Tumors of the adrenal may produce abnormalities of the sexual organs, as virilism. Such changes have never been noted with hypernephroma.—Tuffier (8), Ewing (9*a*), Boyd (1*b*).

(*d*) The hypernephroma is composed of lipoid-filled cells which have the usual vacuolated appearance following routine preparation in alcohol and xylol. According to the Grawitzian school, these cells closely simulate those in the adrenal cortex, but identical cells are found in adenomata of the kidney. Furthermore, the hypernephromata may take on tubular formation, which is never present in the adrenal.—Boyd (1*b*).

Portmann (10), on the other hand, definitely assumes the presence of hypernephroma. He states: "It originates from an inclusion of suprarenal cortical tissue. It is often confused with carcinoma because it is inclined to deviate very consider-

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

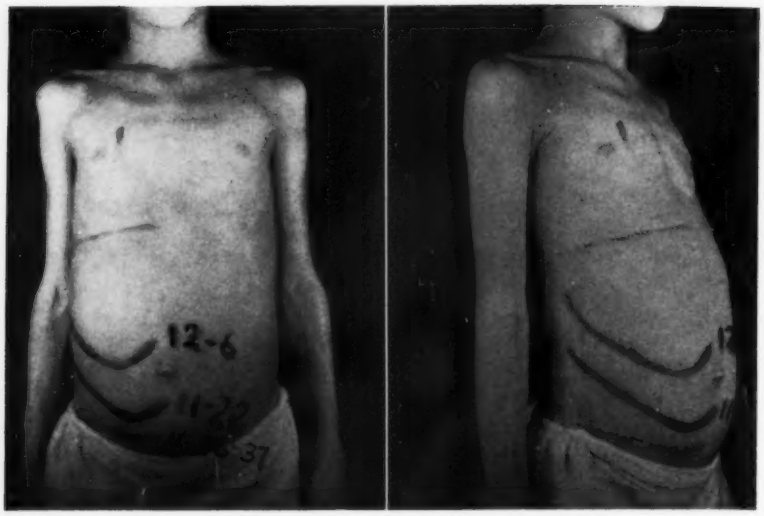


Fig. 1. Wilms' tumor: Radiosensitivity. This tumor shrank as shown by the lower and upper skin markings to approximately a third of its original size. X-ray therapy was begun Nov. 26, 1937. The skin marking dated Nov. 22 was made before the institution of radiotherapy.

ably in its histologic structure; however, these two groups have nothing in common from a clinical standpoint." He (Portmann) continues with the statement that the hypernephroma remains encapsulated for a long period of time and its growth is usually slow, while adenocarcinoma has a tendency to early infiltration and therefore more rapid extension. Furthermore, hypernephromata tend to erode veins and metastasize widely, while adenocarcinomata spread by lymphatic extension.

Ewing (9*b*) takes a more middle ground in that he agrees to the occurrence of adrenal inclusions in the kidney and to the fact that tumors may arise within these rests. He concludes however: "Finally, recent studies have demonstrated that a large proportion of reported hypernephromas are renal adenocarcinomas."

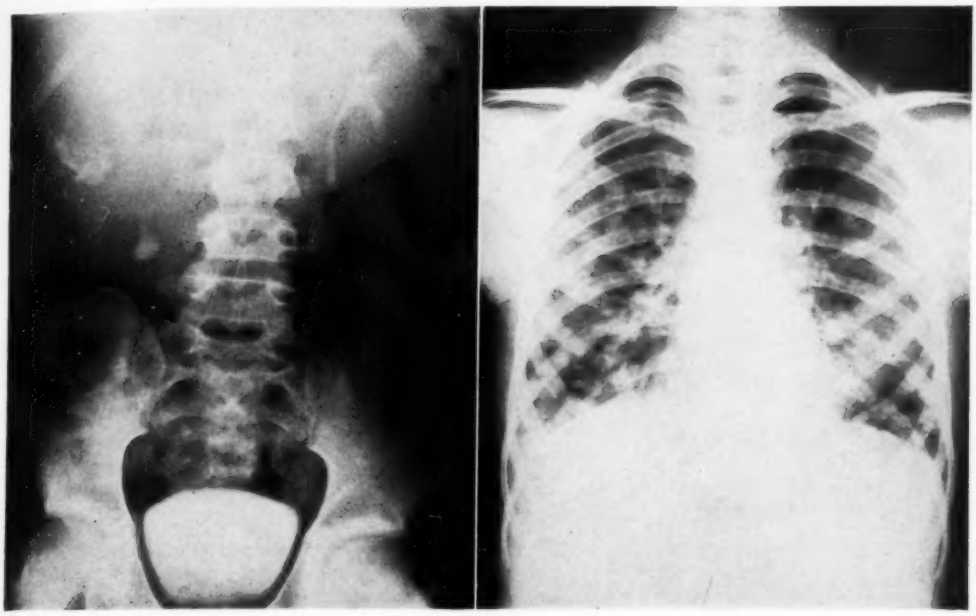
The following working classification of malignant kidney tumors is used at the Brooklyn Cancer Institute:

1. Tumors arising in the kidney cortex.
   (*a*) Papillary adenocarcinoma.
   (*b*) Alveolar adenocarcinoma.
   (*c*) Adenomyosarcoma (Wilms' tumor).
2. Tumors arising in adrenal rests. Hypernephroma.
3. Tumors arising in the kidney pelvis.
   (*a*) Papillary epithelioma.
   (*b*) Alveolar carcinoma.

PATHOLOGY

1. Tumors Arising in the Kidney Cortex: (*a*) The *papillary adenocarcinoma* is the most common type of neoplasm arising in the kidney parenchyma. This tumor is the one most frequently confused in the literature with hypernephroma. Microscopically, there is a distinct tendency to papillomatous structure with distinct gland formation. Interstitial hemorrhage occurs frequently. According to Portmann, these neoplasms do not remain encapsulated but infiltrate rapidly through the kidney. They do not erode venous channels as frequently as does the so-called hypernephroma and therefore are more apt to metastasize by lymphatic extension.

(*b*) *Alveolar adenocarcinoma* is subdivided by Ewing (9*c*) into adenocarcinoma (i) of infants and (ii) of adults and (iii) tubular adenocarcinoma reproducing renal tubules. The embryonal carcinomas (i



Figs. 2 and 3. Wilms' tumor with metastasis to lung. On intravenous pyelography, only the lower calix filled with dye. The opacity above represents calcium in the tumor. Before death metastases appeared in the brain, cranium, and pelvic bones, as well as in the lung.

and ii) retain many of the characteristics of the Wilms' tumor except that the sarcomatous elements are lacking. All of the cases in the series recorded here actually belong to the last group (iii), namely, those reproducing renal tubules. Here the pathology is characteristic in that the formation strongly simulates that of normal kidney tubules. The cells are clear or granular, with central small, dark-staining nuclei. There is little supporting structure.

(*c*) The embryonal structure of *adenomyosarcoma* (*Wilms' tumor*) is most striking. It usually consists of distorted renal tubules, with scattered abortive glomeruli. Such areas are interspersed with zones of sarcomatous spindle cells. These latter elements may consist of voluntary or involuntary muscle. Wilms' tumor grows very rapidly and in most instances a large mass is palpable in an infant before other symptoms become manifest. The immediate response to irradiation is at times most gratifying, in that a tumor will shrink to a half or a third of its original size within a few weeks (Fig. 1). Here again there is a tendency to early and widespread metastasis, particularly to lung and bone (Figs. 2 and 3).

2. Tumors Arising in Adrenal Rests (*Hypernephroma*): These Grawitzian tumors are characteristic according to Ewing (9*d*). "They are large, well circumscribed, yellowish, fatty and vascular tumors, prone to hemorrhage, necrosis, and cyst formation." Ewing eliminates from this classification "all tumors with distinct lumina, and especially those of papillary structure." The cells appear to grow diffusely but may be arranged in "small circular groups separated by fine strands of connective tissue." Thus on the basis of the cellular characteristics alone this tumor can easily be confused with the papillary adenocarcinoma, and the author, after careful review of all the slides, is unwilling to list any of the neoplasms in his series as true hypernephroma but has placed them all under the classification adenocarcinoma. There are, however, 16 specimens that

would fit in with the above morphological grouping of hypernephroma.

3. Tumors Arising in the Kidney Pelvis: Tumors having their origin in the kidney pelvis represent but 7 per cent of the total number of renal tumors. Because of their location, bleeding is an early symptom and the pelvic deformity is readily recognized on the x-ray film. These pelvic defects must be carefully differentiated from non-opaque calculi, blood clots, and disease of the calices, as tuberculosis. None of this group has been found in the records of the Brooklyn Cancer Institute.

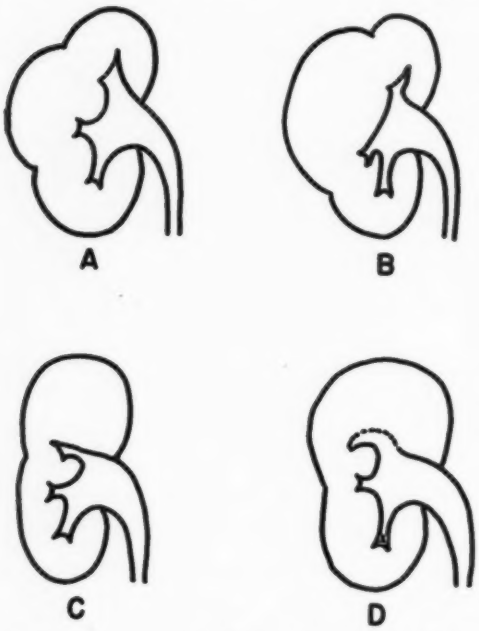


Fig. 4. Schematic drawing of renal cortical carcinoma. A. Lobular distortion of renal shadow without involvement of the calices. B. Adjacent calices are spread by growth. C. Single calix is displaced. D. Hooking and elongation of involved calix.

(*a*) *Papillary epithelioma* arising in the renal pelvis is of very rare occurrence (Kerwin, 11). Its papillary, warty structure is characteristic. It tends to metastasize down the ureter and into the bladder.

(*b*) *Alveolar carcinoma* is the more common of the pelvic tumors. In the early stages these growths have a flat appearance. They infiltrate readily into the surrounding kidney parenchyma and are highly malignant.

DIAGNOSIS

The prompt recognition of the cortical kidney tumors is often difficult. These neoplasms will often remain silent for years before localizing symptoms lead to their recognition. The x-ray film usually gives the most direct evidence (Fig. 4). When the growth is situated well to the periphery, the calices will not be disturbed, and the diagnosis can be made only by a careful study of the (A) kidney outline. This surface distortion can be confirmed by perirenal air insufflation. The growth may (B) spread two adjacent calices or (C) may displace a single calyx. Braasch (12) has brought out the typical (D) elongation and hooking of the involved calix. Of course, the larger the tumor the bigger and more deformed is the kidney shadow and the more distorted the calices.

Bone metastases are usually characteristic in that they consist of massive zones of cortical and spongy bone destruction not associated with any periosteal, cancellous reaction or new bone formation. They often involve the ends of long bones, as the neck and head of the humerus. Pathological fracture is frequent and is often the earliest presenting symptom. Bone regeneration is not initiated by this fracture, as commonly occurs in the case of giant-cell tumors or metastases from mammary carcinoma. No trabeculation is present within the tumor area, nor is there expansion of the cortex, as with giant-cell tumor (Fig. 5). These metastases are rarely multiple and do not consist of concentric globular areas of destruction such as are seen in multiple myeloma.

The lung metastases are usually cottony, irregular masses present in the hilar zones or lower third of each lung field. Their location and wide distribution suggest hematogenous extension.

STATISTICAL REVIEW

The Brooklyn Cancer Institute was transferred to its present location in Octo-

ber 1936, and not all of the earlier records are available for review. To date, 54 patients (43 since October 1936), out of a total of 6,400, have been admitted to the Brooklyn Cancer Institute with a diagnosis of a primary malignant tumor of the kidney, representing 0.65 per cent of all admissions.

Of this group of cases, 45 were proved by nephrectomy or autopsy and 9 have no pathological confirmation. In all of the latter, however, roentgen determination of kidney deformity and proof of metastases to lung were obtained, and bone metastases were demonstrable in 7 instances. Such findings are considered of sufficient weight to justify inclusion of the case in summation of end-results.

The cases with pathological confirmation (including 2 omitted from the statistical review) are classified as follows:

1. Tumors arising in the kidney parenchyma.	
(*a*) Papillary adenocarcinoma	35
(*b*) Alveolar adenocarcinoma	5
(*c*) Adenomyosarcoma (Wilms' tumor)	5
2. Tumors arising in adrenal rests. Hypernephroma (see heading 2 under Pathology)	0
3. Tumors arising in the kidney pelvis.	
(*a*) Papillary epithelioma	0
(*b*) Alveolar carcinoma	0
4. Embryonal tumor (not classified)*	1
5. Neurocytoma, perirenal†	1
TOTAL with pathological proof	47

[* The embryonal tumor was never satisfactorily classified. At operation only a small biopsy specimen of a cyst wall was obtained. The patient died about one year later of metastasis. This case is not included in the summary because of the indefiniteness of the pathological diagnosis.

† The perirenal neurocytoma was discovered as a palpable kidney mass in a four-months-old infant (Fig. 6). On a clinical diagnosis of Wilms' tumor, preoperative x-ray therapy was given. At operation the tumor was successfully stripped from the lower pole of the kidney. To date (two years) there has been no recurrence. This case is eliminated, as the tumor did not actually arise within the kidney.]

Cases proved by x-ray film of kidney and metastases (microscopic pathology not obtained.)	9
Cases proved by nephrectomy or autopsy	45
TOTAL	54

We have, thus a total of 54 cases of malignant renal tumors, 45 of which are proved by gross and microscopic pathologic studies. Thirty-six patients were males and 18 females, a 2 to 1 ratio. Eliminating the 5 cases of Wilms' tumor, the oldest patient had reached his 79th year and the youngest her 9th year; the average age was 49.6 years.

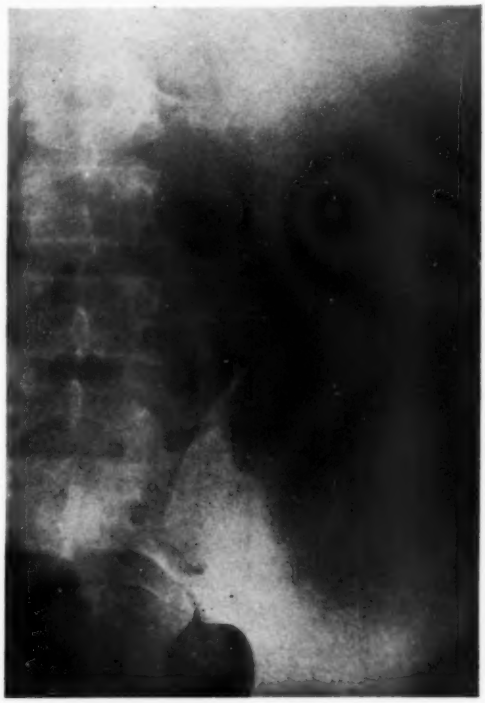


Fig. 5. Metastasis to ilium from adenocarcinoma. The large wiped-out defect in the ilium was diagnosed as a giant-cell tumor, in spite of lack of trabeculations and cortical expansion. The greatly enlarged left kidney is clearly seen above.

It is well known that these cortical tumors are prone to remain symptomless for a long period of time. In 14 of this series, or approximately 1 in 4, the presenting symptom first referred to was due to the presence of a metastasis (Fig. 5).

Pain was the outstanding and the first symptom in 29 instances. Hematuria was the earliest sign in 21 cases; in 4 the first indication of trouble was the detection of an abdominal tumor. Only 11 persons in the whole group are still living, and but 5

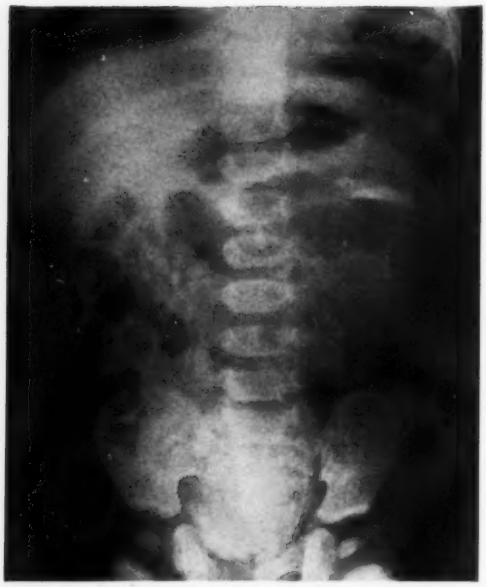


Fig. 6. Perirenal neurocytoma. The tumor is attached to the lower pole of the kidney, displacing and rotating the kidney as shown by the changed axis of the pelvis.

of these have been carried over three years without known metastases. Table I lists the cases according to year of admission, with end-result. The 11 cases with survival to date may be summarized as follows:

1. L. F., male, age 66, living seven years following nephrectomy without evidence of metastasis. Papillary adenocarcinoma.

2. L. S., female, age 12, living five years following nephrectomy, without evidence of metastasis. Papillary adenocarcinoma.

3. P. R., male, age 45, living five years after nephrectomy, without evidence of metastasis. Papillary adenocarcinoma.

4. E. B., female, age 63, living five years following nephrectomy. X-ray evidence of one metastasis to a dorsal spinous process in 1939. This has not changed in four years and therefore probably represents a bone cyst. Alveolar adenocarcinoma.

5. M. S., female, age 9, living seven months following nephrectomy and three and a half years after admission. This patient had extensive preoperative radiation therapy. Her case is described below. Adenocarcinoma, Grawitz type.

6. D. L., male, age 48, living two years following admission. This is the only living patient who has not undergone nephrectomy and who is without pathological proof of neoplasm. He is included in this series because of demonstrated defect in a renal calix. He also has a pathological fracture of the right femoral neck.

7. K. Z., female, age 24, living one year following nephrectomy, without metastases. This patient has had postoperative radiation therapy. Wilms' tumor.

8. L. K., female, age 63, living one year following nephrectomy. She has both local recurrence and metastasis to lung. Papillary adenocarcinoma.

9. E. L., female, age 66, living 4 months following nephrectomy. She has no demonstrated metastasis. Wilms' tumor.

10. L. C., male, 42 years, living 2 months following nephrectomy. He has demonstrable metastases in the ilium and dorsal spine. Adenocarcinoma, Grawitz type.

11. F. W., male, age 7 years, living 2 months following nephrectomy. This patient received preoperative radiation therapy. No metastases have been demonstrated to date. Wilms' tumor.

TABLE I: END-RESULTS IN 54 CASES OF KIDNEY TUMOR

Admission Year	Number of Cases	Nephrectomy	End-Result		Average Survival Period	
			Living	Dead	Living (months)	Dead (months)
1936 and before	11	10	1	10	84	23
1937	4	2	0	4	0	4
1938	14	9	3	11	60	12
1939	5	3	0	5	0	15
1940	5	5	1	4	42	7
1941	8	4	1	7	26	5
1942	2	2	1	1	13	7
1943	5	4	4	1	4	3
TOTALS	54	39	11	43		

Patients 1 to 5 have survived from three and a half to seven years and are the only ones to have passed the more critical interval of the first two years without evidence of metastasis. All others either have known metastases or have not survived a sufficient waiting period to be considered favorably from a prognostic point of view. In this respect, the author has had the experience, in his private practice, of seeing a recurrence of tumor twenty years after nephrectomy.

TREATMENT

Thirty-eight patients have undergone nephrectomy, and but 5 of these have

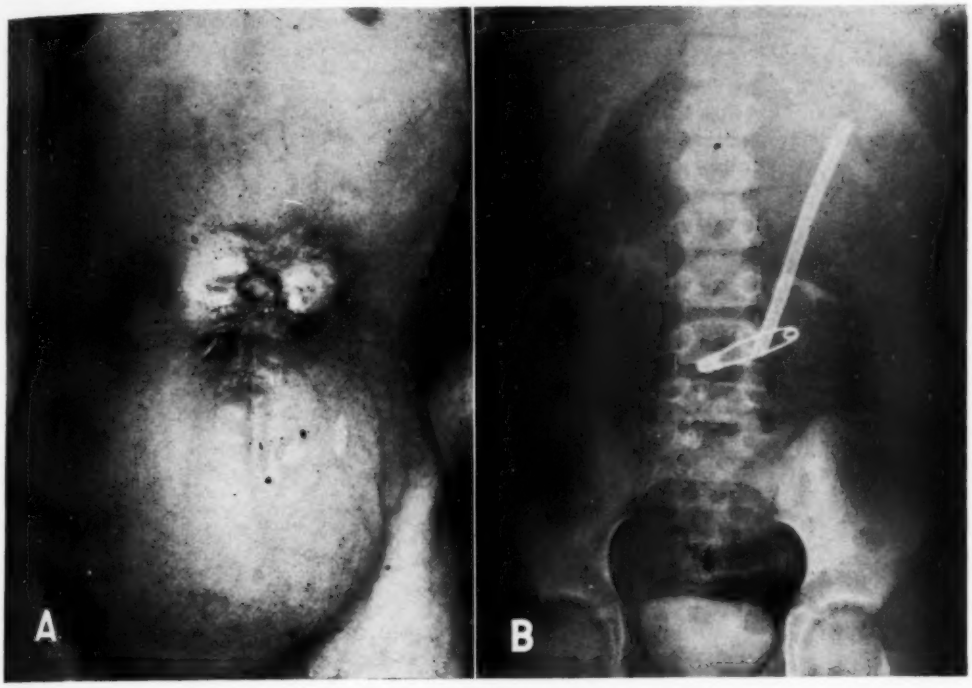


Fig. 7. Adenocarcinoma of Grawitz type (patient M. S.). A. Sinus tract draining from tumor to the anterior abdominal wall. This followed the original exploratory laparotomy. B. A rubber tube extends into the sinus tract. The kidney pelvis is displaced by the tumor in the upper pole.

survived over three years without known metastases, or 1 in 7. Four of the survivors are listed as having papillary carcinoma; the fifth alveolar carcinoma.

Many of these renal tumors are radiosensitive and respond to x-ray therapy, as is attested by Waters (13). Prenephrectomy roentgen therapy is theoretically worth while if it will reduce the size of the tumor and so injure the neoplasm that it is unable to metastasize. Preoperative roentgen therapy was delivered in 3 instances in this series with reduction in the size of the tumor in all cases and with improvement in the clinical condition in 2. One case illustrating clinical improvement following irradiation is summarized as follows:

M. S., a thin, anemic girl of 9 years, was admitted to the Brooklyn Cancer Institute in April 1940. At laparotomy performed in another institution because of a large upper left abdominal mass "size of a watermelon," it was found that the tumor could not be removed but a biopsy was taken. Most of the biopsy specimen was badly broken down and only a few cells could be identified as carcinoma. This operative procedure was followed by infection (Fig. 7A) and on admission to the Brooklyn Cancer Institute a sinus was present in the anterior abdominal wall through which oozed large quantities of a thick purulent material (Fig. 7B).

The upper left abdomen was cross-fired through 3 ports, 200 r being delivered to 2 areas daily, the areas being so rotated that between April 1 and May 11, 1940, an estimated 5,750 r was given to the center of the tumor. This treatment resulted in decreased discharge from the sinus, moderate reduction in the size of the mass, and improvement in the child's general condition. A second cycle of radiation was delivered between Jan. 2 and Feb. 1, 1943, giving an estimated additional tumor dose of 2,750 r. At this time the patient was re-examined and the genito-urinary surgeon determined again to attempt removal of the kidney, this time through a retroperitoneal approach, as an infected sinus tract remained following the first exploration. This time the nephrectomy was successful. The neoplasm in the upper pole of the kidney measured 10 × 6 cm.; the remaining kidney parenchyma was compressed and atrophic, measuring 3 × 3 cm. The microscopic picture was that of carcinoma of the Grawitz type, with radiation changes.

The only complication was a sinus tract (Fig. 8)

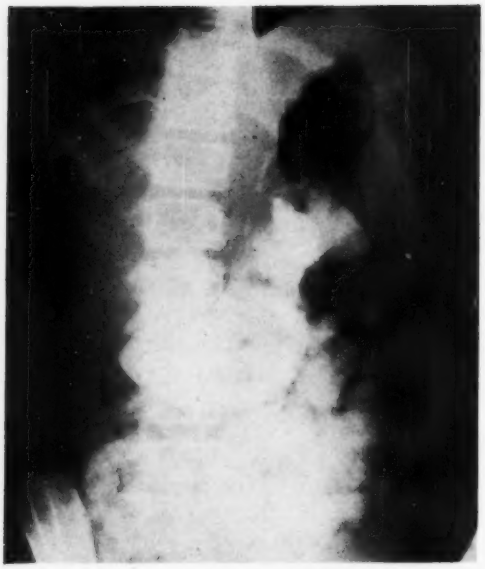


Fig. 8. Adenocarcinoma of Grawitz type (patient M. S.). The stomach and small intestine are flooded with dye injected through the fistulous opening in the nephrectomy scar. This closed without further surgery.

from the nephrectomy wound to the stomach. This was clearly demonstrated when dye injected into the sinus was seen draining into the stomach from the lower posterior angle of the nephrectomy scar. This closed gradually. The little patient has gained perceptibly, having increased in weight from 48 to 56 pounds in three months. Except for a cystic area in the left ilium, about as large as a penny, which has not changed in size in the past year, there is no evidence of recurrence or metastasis to date.

The preoperative radiation therapy definitely cut down the infection present, reduced the size of the tumor, and probably slowed up the extension of the growth for a period of nearly three years.

In the series under discussion postoperative radiation was given in most instances. It is in the treatment of recurrences and metastases that the results appear most discouraging (Fig. 9). The large solitary bone metastases do not show the response to radiation that is often demonstrated following irradiation of bone metastases secondary to a breast carcinoma. The following case report is illustrative:

H. F., a 41-year-old white male, reported to the Brooklyn Cancer Institute in June 1938 with a painful swelling over the sternum. He admitted to nocturia four to five times a night but had never noticed any blood in his urine. On examination, he was found to have a subcutaneous oval swelling, 8 × 6 cm., apparently arising from the body of the sternum. A sense of resistance was felt in the right upper quadrant, suggesting a tumor. On roentgen examination, a greatly enlarged right kidney was demonstrated.

Treatment of Primary Renal Tumor: Between June 20 and July 12, 1938, the right kidney was cross-fired, with but minimal reduction in the size of the kidney mass. On Sept. 30, a right nephrectomy was performed. The pathological report was papillary adenocarcinoma of tubular origin.

Treatment of Sternal Metastasis: X-ray therapy was given from July 21 to Aug. 5, 1938: 2,000 r to 2 areas, an approximate tumor dose of 4,000 r.

Nov. 29, 1938: Twenty radium needles, 35 mm. in length, 2 mg., were inserted into the sternal mass for 100 hours, or an estimated 6,000 gamma roentgens.

Jan. 18, 1939: Twenty-four needles were reinserted into the sternal mass for an estimated 8,000 gamma roentgens. There was moderate shrinkage of the mass after the two interstitial radium treatments (Fig. 10).

March 29, 1939: Twelve needles were inserted into an extension over the manubrium, for an estimated tumor dose of 5,000 gamma roentgens. Except for moderate shrinkage in the mass after the second radium treatment, the growth of this metastasis was not influenced, in spite of relatively large doses of interstitial radium.

Later Course: Metastases appeared in the spine, with collapse, and in the femur, with pathological fracture. None of these metastases was influenced perceptibly by further radiation therapy. The patient died in July 1939, just over one year after admission.

SUMMARY

Prognosis is bad in all renal cortical tumors, since the growth is apt to remain symptomless for an initial period and metastases occur early.

The term "hypernephroma" is often used loosely to designate any renal neoplasm. Evidence has accumulated to cast doubt on the original Grawitz theory that hypernephromata originate from adrenal rests within the kidney.

The primary tumor may be radiosensitive, though the metastases are almost universally radioresistant. In a series of 54 patients with kidney tumor but 5 have survived over three and a half years without evidence of metastasis. All underwent

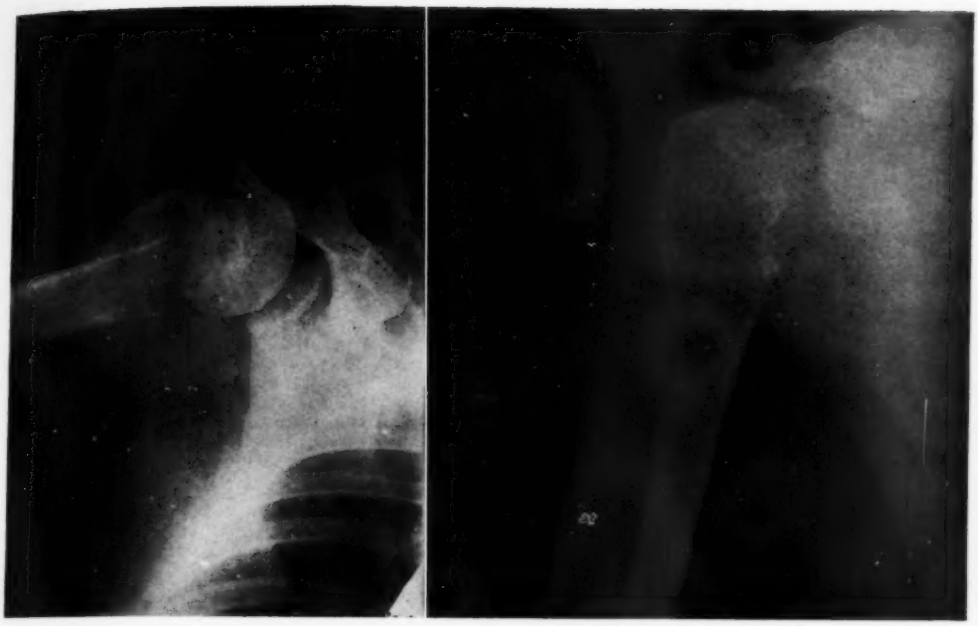


Fig. 9. Adenocarcinoma: Metastasis in right humerus before and after x-ray therapy. There was a two-month interval between the examinations. This is one of the exceptional cases where bone and calcific union took place following irradiation.

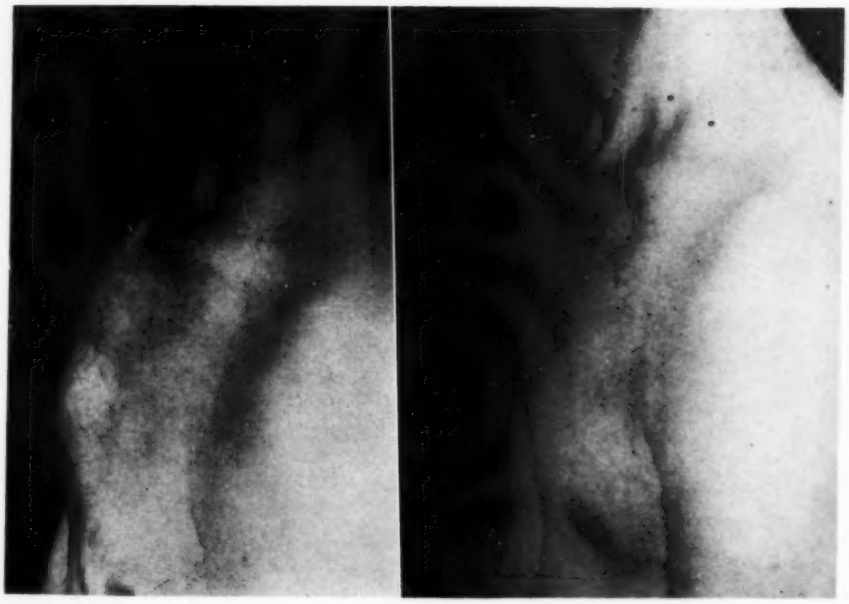


Fig. 10. Adenocarcinoma: Metastasis in sternum before and after irradiation. This metastatic mass received roentgen therapy—4,000 r tumor dose—and two aplications of radium needles, giving estimated doses of 6,000 and 8,000 gamma roentgens, respectively, with only moderate reduction in size.

nephrectomy and received postoperative radiation therapy. One (M. S.) received large amounts of prenephrectomy roentgen therapy.

SUGGESTIONS

As leading symptoms are at first masked, the presence of kidney tumor should be considered among the differential diagnoses in all cases of unexplained back pain or loss in weight or strength. Transient hematuria should never be disregarded by the attending physician.

Diagnosis may be clinically established by roentgenography in conjunction with other clinical and laboratory findings. Large isolated secondary deposits in bone can be recognized and should not be confused with primary bone tumors, as giant-cell tumor, multiple myeloma, or sarcoma. Further studies as to the value of preoperative roentgen therapy appear to be warranted.

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Malignant Tumors of the Kidney: Review of 117 Cases[1]

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FROM 1924 TO 1940, inclusive, 117 cases of malignant renal neoplasms were seen in the University of Minnesota Hospitals. The follow-up period extended to the end of 1942. In this group there were 94 cases of carcinoma of the renal cortex, 13 cases of Wilms' tumor, 9 cases of carcinoma of the renal pelvis, and one of sarcoma.

HISTORICAL

The first reported case of carcinoma of the renal pelvis was that of Hedenius and Waldenstroem in 1878 in a 79-year-old man.

Grawitz in 1882 first described the tumor which bears his name. He recorded a typical case under the name of "struma aberrata suprarenalis" and showed its resemblance to adrenal structure. Harris in the same year described an adrenal-like tumor of the kidney, which he called "alveolar sarcoma of the renal capsule." Rokitansky, in his textbook, in 1861, gave what Newcomb states is a clear description of a Grawitz tumor. Later Birch-Hirschfeld introduced the term "hypernephroma."

At first, most investigators accepted the Grawitz theory of the suprarenal derivation of this tumor, but in 1908 Stoerck brought forth his findings favoring a renal rather than a suprarenal origin. From that time on the controversy has raged, and even to this day there is not unanimous agreement. At the present time the consensus seems to be definitely in favor of a renal origin.

The first accurate description of a mixed tumor of the kidney was apparently given by Eberth in 1872. Prior to that time all malignant tumors of the kidney were thought to be carcinomas. Eberth believed these tumors came from inclusions of the wolffian body because of the presence in it of embryonal muscle cells, which he thought accounted for the presence of striated muscle fibers in the tumor. Other investigators, however, later showed these to be non-striated muscle fibers. Cohnheim in 1875 and Ribbert in 1886 attributed the origin of these tumors to aberrant germ plasm. In 1894 Birch-Hirschfeld reviewed the literature and agreed with Eberth that the origin is in the wolffian body. He suggested the term "adenomyosarcoma" for these mixed kidney tumors.

Wilms in 1894 wrote his classic monograph in which he presented the theory of origin that is generally accepted today. He believed the anlage of the tumor to be a fragment of primitive, undifferentiated mesodermal tissue of the type which gives rise to the myotome (source of striated muscle), the sclerotome (source of vertebral anlage), the nephrotome (wolffian body anlage), and the mesenchymal tissue from which smooth muscle takes its origin.

Busse in 1899 disagreed with Birch-Hirschfeld, stating that remnants of the wolffian body are not found in the kidney. He and Muus thought that the tumor arose from a segregated portion of renal blastema which failed to develop normally. Frazer in 1920 summarized the modern views of its origin. Hinman and Kutzmann suggested in 1924 that the simple tumors, the so-called sarcomata, can be explained by Birch-Hirschfeld's theory and the complex ones by Wilms' theory.

Geschickter and Widenhorn in 1934 proposed the term "embryonal nephroma." They state that the majority of these tumors are neither teratomatous nor mixed but represent a neoplastic exaggeration of

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normal growth processes in the growth zones of the renal cortex in late fetal life and the first few months of infancy.

The first successful removal of a Wilms' tumor was by Jessop of England in 1877 from a $2^1/_2$-year-old boy, who died nine months later of a recurrence. Israel recorded the first surgical cure in 1894, in a 14-year-old boy on whom he had operated in 1888.

Heimann, in 1915, reported the first use of postoperative x-ray therapy on a Wilms' tumor. A nephrectomy was performed in July 1913 and irradiation was started in August. The patient received eight treatments but died three months later from metastases. Friedlaender in 1916 presented one of the first cases in which x-ray irradiation was used as a primary treatment. The tumor decreased in size but at autopsy, a few months later, metastases were found in the lungs and liver. The first preoperative x-ray therapy was apparently reported by Geraghty in 1923. It was intended to reduce the size of the tumor preparatory to operation, but the patient disappeared and did not return for nephrectomy. He was later found to have died, five and a half years after treatment.

For a more complete survey of the history of renal tumors, the reader is referred to the articles by Gilbert (29) and Kretschmer (30).

CLASSIFICATION

The classification of renal tumors which we have used is as follows:

I. Renal Tumors in Children
  A. Benign
    Multiple tumors with tuberose sclerosis
  B. Malignant
    Wilms' tumor

II. Renal Tumors in Adults
  1. Parenchymal
    A. Benign
      (*a*) Fibroma
      (*b*) Leiomyoma
      (*c*) Lipoma
      (*d*) Hemangioma
      (*e*) Adenoma
    B. Malignant
      (*a*) Liposarcoma
      (*b*) Fibrosarcoma
      (*c*) Adenocarcinoma (hypernephroma)
      (*d*) Wilms' tumor
  2. Pelvis
    A. Benign
      Papilloma
    B. Malignant
      Carcinoma

This classification was presented in a previous publication by Bell (1).

ADENOCARCINOMA OF THE KIDNEY CORTEX (*Hypernephroma*)

Adenocarcinomas of the kidney cortex form by far the largest group in this series of malignant renal neoplasms, numbering 94, or 80 per cent, of the 117 cases. We regard adenocarcinoma of the renal cortex the same as hypernephroma. The disagreement which formerly existed regarding this neoplasm seems to be disappearing, and there is now a fairly general acceptance of its renal rather than suprarenal origin (2, 3, 8, 9, 14, 16).

TABLE I: AGE DISTRIBUTION OF 94 CASES OF CARCINOMA OF THE RENAL CORTEX

Age	Proved Cases	Unproved Cases	Total
10–20	1	0	1(1%)
20–30	3	0	3(3%)
30–40	2	0	2(2%)
40–50	22	6	28(30%)
50–60	22	4	26(27%)
60–70	30	3	33(35%)
70–80	1	1	2(2%)

Of the 94 cases of carcinoma of the cortex, 81 were proved by histologic examination. The remaining 13, in which, for some reason, nephrectomy or biopsy was not done, were diagnosed on the basis of clinical symptoms, urography, and gross appearance of the tumor at operation.

Carcinoma of the renal cortex occurs almost entirely after the age of forty. In this series only 6 per cent of the patients were less than forty. Neff (23) reported 18 cases all beyond the age of forty. In MacKenzie and Parkins' (7) series 84 per cent were over forty and in Smith and Young's (22) 80 per cent. In a series pub-

TABLE II: SYMPTOMS IN 96 CASES OF CARCINOMA OF THE RENAL CORTEX COMPARED WITH OTHER REPORTED SERIES

	Author's Series		MacKenzie and Parkins	Smith and Young	Judd and Hand	Hyman	Belchor	Neff	Chute
	No.	%	%	%	%	%	%	%	%
Hematuria					69	80	..	36	88
Initial	21	22	38	48	..	..	35	..	..
Associated	43	46	24	16	..	..	18	..	..
Pain					83	30	..	28	60
Initial	16	17	43	34	..	..	..	..	..
Associated	42	45	30	36	..	..	..	..	..
Mass					78	80	..	12	62
Initial	11	12	8	9	..	..	5	..	..
Associated	22	24	54	29	..	..	42	..	..
Weight Loss									
Initial	7	8	..	..	..	..	..	..	..
Associated	12	13	..	..	..	..	..	..	..
Weakness									
Initial	5	5	5	6	..	..	..	..	..
Associated	8	9	18	17	..	..	..	..	..

lished by Judd and Hand (14) the average age at onset of symptoms was fifty-one years. The average age of the patients in our series at their first hospital visit was 53.4 years. The youngest was eighteen and the oldest seventy-six. Incidentally, the 18-year-old patient is alive and well, having been dismissed from follow-up eleven years after nephrectomy and x-ray therapy. Table I shows the age distribution of our cases.

Males were affected more frequently than females in this series, there being 59 men (63 per cent) and 35 women (37 per cent). In most of the other reported series, the relative frequency in men has been even higher. Belchor (6) and Priestley (16) reported 70 per cent males, Hyman (2) 74 per cent, Judd and Hand 68 per cent, and Neff 91 per cent.

The complaints varied considerably, but there were some which were found consistently enough to be of significance. Hematuria, pain, abdominal mass, weight loss, and weakness were most common. Hematuria, as either an initial or associated symptom, was present in 64 of the 94 cases. Pain was present in 58 cases, an abdominal mass in 33, weight loss in 19, and weakness in 13. Varicocele is frequently mentioned as a symptom, but in our series it was encountered only once.

Table II shows the frequency of the various symptoms occurring initially and in association with others, along with the frequency in several other reported series. By initial symptom, we mean *single* initial symptom, unassociated with other symptoms until possibly later. If two or more symptoms appeared simultaneously, they have been listed as associated symptoms.

Hematuria was the initial symptom in 21 (22 per cent) of the cases and an associated symptom in 43 (46 per cent), making a total incidence of 68 per cent. Belchor reported hematuria in 53 per cent, Judd and Hand in 69 per cent, MacKenzie and Parkins in 62 per cent, Hyman in 80 per cent, and Smith and Young in 64 per cent.

Hematuria may be an early or a late symptom. It may be early clinically and late pathologically. It occurs when there has been an invasion of the renal pelvis or calices or, as Ljunggren (38) has pointed out, when there is venous stasis of the mucosa of the renal pelvis. Patients have presented themselves at the University Hospitals within two weeks after the first episode of hematuria only to find the tumor inoperable or metastases already present. Between bouts of hematuria there is not infrequently an interval, which may be as much as several months, during which the urine is normal, at least macroscopically. This quiescent period may be

dangerous since it may give the patient and even the physician a false feeling of security and the opportunity of making an early diagnosis may be lost. Obviously, every patient with hematuria deserves a complete examination, including urography. Several of our patients have had a history of intermittent hematuria for several years. It is difficult to establish whether the carcinoma was present during all those years or whether there was another basis for the bleeding. Certainly some malignant tumors of the renal cortex can be quite slow growing. Carlson and Ockerblad (34) report a case in which an x-ray and clinical diagnosis of carcinoma of the cortex was made. The patient refused surgery. Ten years later he was again seen and the tumor was found to be somewhat larger. This time a nephrectomy was done and a carcinoma of the cortex was found. Apparently the neoplasm had been present for all those years and yet was operable. This, of course, is an exception to the course these tumors ordinarily take.

Even though hematuria may frequently be a late symptom, it nevertheless seems that it is the one most likely to bring the patient to the physician in time to make possible an early diagnosis. When he comes because of weight loss, weakness, pain, or a mass, the disease is almost surely advanced.

Next to hematuria, pain was the most common complaint, occurring in 58 (62 per cent) of the 94 cases. Pain has been a frequent symptom in most of the reported series, having an incidence as high as 83 per cent in one series (Judd and Hand). It was most frequently located in the back and almost always in the lumbar region. Thirty-one patients complained of backache. Pain was present in the abdomen in 18 cases and in the flank in 6. There were only 3 cases of typical renal colic, and in one of these renal stones were present along with the tumor.

It is difficult to evaluate the significance of backache in these patients. Most of them are in the age group where some degree of backache is not unusual, and in those cases in which it was present for several years the connection with the neoplasm might well be questioned. Two patients complaining of backache for seven and five years, respectively, were both alive and well at the close of the study, the first for a period of seven years and the second for five years. The patient complaining of backache for five years had hematuria for the same length of time, and in this case it seems reasonable that the backache was related to the tumor for this period. The other patient had no other complaints until one and a half years before coming to the University Hospitals, at which time she had her first attack of hematuria. The relation of the backache to the carcinoma for the five and a half years during which other symptoms were absent may well be questioned.

An abdominal mass was present in 33 (36 per cent) of the 94 cases. Many of the patients were not aware of the actual presence of a mass but experienced only a feeling of fullness and abdominal discomfort.

The classical triad of symptoms of carcinoma of the kidney cortex, namely, hematuria, pain, and abdominal mass, was present in only 10 cases, which is somewhat lower than in some other series. Belchor found 25 per cent presenting this triad, and Chute 31 per cent.

Nineteen patients complained of weight loss and in 7 of these it was the initial symptom. It is interesting to note that 5 of these 7 patients lived less than six months after first being seen at the University Hospitals. Weakness was the initial symptom in 5 cases and an associated symptom in 8.

Occasionally, there are cases in which none of the symptoms is associated with the urinary tract, and in that event much valuable time may be lost before attention is finally turned in the proper direction. Fifteen of our patients complained only of weakness, weight loss, epigastric distress, cough (from lung metastases), backache, or a combination of these symptoms, and the true nature of the lesion was not ap-

parent until after some study. In some cases, metastases in the lungs or bone may be the first indication of the presence of the renal lesion. Rolnick (26) found 14 out of a series of 54 cases in which none of the symptoms was referable to the urinary tract.

Metastases were demonstrated at the time of diagnosis in 14 of our 81 proved cases of carcinoma of the cortex. The site of metastasis was the bones in 7 cases, the lungs in 6, and the liver in 3. Late metastases are known to have developed in 28 of the 81 cases, the bones being the site of involvement in 13 cases, the lungs in 11, and the liver in 5. The frequency of bone metastases has been noted by Ewing (43) and others.

There is some question as to the advisability of nephrectomy in the presence of metastases at the time of diagnosis. In our series, nephrectomy was performed only 4 times when metastases were known to be present. One of these patients lived slightly more than one year, and each of the other 3 lived less than one year. Hyman is of the opinion that pulmonary or bone metastases not producing marked systemic effects, in the absence of cachexia, do not contraindicate nephrectomy. Ljunggren (44) is of this same opinion and cites a case in which a single pulmonary metastasis was followed after nephrectomy for three years, with only slight increase in size. On the other hand, Braasch and Griffin believe nephrectomy is contraindicated in the presence of pulmonary metastases and cite the fact that all 6 of their patients in this category lived less than one year (5). Waters (37) also feels that metastases are a contraindication to nephrectomy. It is our opinion that nephrectomy is not contraindicated by a single small metastatic lesion in one lung or in the bone, as such patients may have a considerable life expectancy.

Attempts have frequently been made to correlate the size of the tumor with the prognosis. It is well known that patients have survived for many years following the removal of a large kidney tumor with no evidence of metastases at the time of surgery or subsequently. It is also well known that very small tumors—even as small as 1.5 cm. in diameter—may metastasize early. Obviously, no hard and fast rule can be laid down correlating the size of the tumor with the prognosis. In general, however, it seems that the prognosis is poorer with the larger tumors. That was true in our series, although the difference was less marked than in some of the other series. For the cases in which the tumor was less than 5 cm. in diameter or weighed less than 500 gm., the five-year survival rate was 50 per cent, whereas in the group in which the tumor was 10 cm. or more in diameter or weighed 1,000 gm. or more, the five-year survival was 38 per cent. In his series, Priestley (16) reported a 46 per cent five-year survival in the group in which the tumor weighed less than 500 gm., whereas for the group in which it weighed more than 1,000 gm. the figure was only 24 per cent. Bell has made the observation that metastasis is much less common in tumors less than 5 cm. in diameter than in those having a greater diameter. Out of a group of 149 autopsy cases which he reported, only 5 of the 65 cases in which the tumor measured less than 5 cm. in diameter showed metastases, whereas in the group in which the diameter exceeded 5 cm., 66 of 84 patients had metastases. It is interesting to note that in our series, in the group in which the tumor was small, 20 per cent expired in one year or less after first being seen at the Hospital, while the corresponding figure for the group in which the tumor was large was 42 per cent. Braasch and Griffin believe that fixation of the tumor is of greater prognostic import than its size.

Many writers have attempted to establish a correlation between the architectural pattern of the carcinoma and its degree of malignancy, classifying the lesions as alveolar, tubular, cordon, adenomatous, papillary, etc. However, as Bothe (36), Portmann (35), Hunt and Hager (8), Bell (1), and others have pointed out, two, and even several, of these patterns

may exist in the same lesion. It would seem, therefore, that any classification or estimation of malignancy based upon the cellular arrangement of the lesion is likely to be unsatisfactory. This procedure may have some advantages, but we have not used it.

We believe that irradiation of metastases and recurrences is definitely worth while. Whether or not life is actually prolonged is a debatable question and one difficult to prove. There can be no doubt, however, as to the value of the procedure in palliation; the relief of pain and the return to a fairly normal life, even though temporary, make it a justifiable procedure. We have seen patients who have had almost constant pain and have been incapacitated by metastases, who, after a series of x-ray treatments to the metastatic lesions, were completely relieved of their suffering and were able to carry on a fairly normal life for many months, in some cases even for years. In this series, 25 patients received x-ray therapy to metastases or recurrences. Of this group, 9 lived one year or more following the course of irradiation, while 16 lived less than a year. Of the 9 patients who lived one year or more, one is still living seventeen months after irradiation of metastases in the lungs and one died two years and three months after irradiation of pulmonary lesions. Two patients expired three and a half years after therapy to bone metastases, and one four years after irradiation of cervical node metastases. Dean (18) is of the opinion that pulmonary metastases may be radiosensitive but he does not believe that bone metastases are. Koenig and Culver (4), however, feel that metastases to bone are frequently radiosensitive. In our few cases, the bone metastases have responded fully as well as the pulmonary metastases, and the relief of pain, which so frequently accompanies metastases in bone, is usually gratifying.

The value of x-ray therapy in carcinoma of the renal cortex, except for palliation, is a controversial subject. It seems to be agreed that irradiation alone is not enough to control the disease and is only palliative (3, 18, 19, 21). Most writers feel that irradiation in conjunction with nephrectomy offers the best hope of cure. Munger (19) believes that preoperative irradiation is useful but warns that surgery should not be delayed following the completion of the treatments; the interval was never more than fourteen days in his series. Waters and Lewis (20), Kerr (45), and Dean also recommend preoperative irradiation. Dean suggests that preoperative x-ray therapy may partially prevent the dissemination of tumor cells at the time of operation, and in this opinion is supported by Munger. Preoperative irradiation may also, by reducing the size of the tumor, greatly facilitate nephrectomy. One of our patients was operated upon in March 1938, at which time a nephrectomy was contemplated. However, because of the size of the tumor and its adherence to surrounding structures, it was considered inoperable and nephrectomy was not done. The patient was then referred to the X-ray Department, where 1,450 tissue r were given to each of three fields in twenty-five days. In July, six weeks after completion of the course of x-ray treatments, a nephrectomy was successfully done. A course of postoperative irradiation, 1,450 tissue r to each of three fields, was given and, when last heard from in August 1943, the patient was alive with no evidence of disease.

The value of postoperative irradiation is not established. Hyman and Kerr do not believe it is of any value. Braasch and Griffin state that it has not been shown to be of much value in their experience. Portmann, however, recommends its routine use. He feels that cells which may have been left behind following nephrectomy may be rendered dormant and less likely to cause metastases. Dean does not agree with this and states that if the tumor is not entirely removed, x-ray therapy may delay but will not prevent a recurrence. Bothe (36) formerly favored irradiation and recommended that it be used in all malignant kidney tumors, but in a recent

article (21), he has reversed his former opinion and now feels that x-ray therapy does not improve the prognosis but is only palliative. It seems that to date no one has proved by statistical studies that postoperative irradiation leads to additional cures, but it does not seem improbable. Undoubtedly it delays the growth of possibly remaining cancer cells and for that reason we have considered it worth while in certain cases.

Rigler (46) is of the opinion that urography is of considerable value in the diagnosis of renal tumors. In those cases in which attention is first directed to a metastatic lesion, or in which the symptoms are vague and not particularly suggestive of disease in the urinary tract, excretory urography may be helpful in determining if a kidney is the site of the primary lesion. If the symptoms are referable to the urinary tract, excretory urography is helpful in determining the side involved. If this examination is negative or inconclusive, a retrograde pyelogram should be made.

TREATMENT OF CARCINOMA OF THE RENAL CORTEX

The treatment in this series of carcinomas of the renal cortex consisted of nephrectomy, nephrectomy plus irradiation, and irradiation alone. Whereas, in obtaining the figures which were presented in connection with the clinical picture, both the 81 proved cases and the 13 unproved cases were used, in compiling the survival figures and results of treatment only the proved cases were considered.

It is not within the scope of this paper to present or discuss the details of the surgical treatment. The results obtained in the cases in which surgery was used, either alone or in conjunction with irradiation, will be presented later.

The radiation therapy in this series was administered by a mechanically rectified unit, operating at 200 kv.p. and 30 ma. with 1 mm. of copper and 1 mm. of aluminum filter. The half-value layer was 1.4 mm. copper. At the present time we are using 400 kv.p. and a half-value layer of 4 mm. of copper for the treatment of kidney tumors, but the machine permitting these factors was not available when the patients in this series were treated. Irradiation of the kidney area was usually through one anterior, one lateral, and one posterior field. The size of the fields varied with the size of the lesion and degree of extension into adjacent structures. A target-skin distance of 70 cm. was used for the anterior and posterior fields and 60 cm. for the lateral field. In the average case, one field was treated daily, the average daily dose being 250 r/air. The total amount given varied considerably. The largest amount given in one continuous series was 3,800 tissue r to the tumor in four weeks. This patient received 2,300 r/air to each of the three fields. Several patients received over 3,000 tissue r to the tumor, but the average tumor dose amounted to about 2,200 to 2,500 tissue r in the cases in which the series of treatments was completed. Six patients did not finish the series of treatments and failed to receive the amount of radiation which was planned for them.

Impiombato (13) states that the kidneys are among the least sensitive of all the organs and are practically unaffected by a dose of 2,000 r. Thus it would appear possible to give a considerably larger dose than this to the tumor without damaging the normal renal tissue. Dean (3) gives "a single portal 250 r daily until each (of 3 fields) has received 2,500 r." Waters (37) recommends "daily doses of 250 r" to each of three fields—anterior, lateral posterior—and in his cases the tumor dose varied from "1,100 r, the smallest, to 3,500 r, the largest." Munger gives multiple ports 300 r in air per day in rotation until "2,100 to 3,000 r per skin area" have been given.

It is advisable to observe patients closely during treatments. Blood counts should be made every few days and if there is any appreciable drop, therapy should be discontinued temporarily. A total white cell count of 3,000 has been adopted arbitrarily as the low level at which radiation

TABLE III: SEVENTEEN CASES OF PROVED CARCINOMA OF THE RENAL CORTEX TREATED BY NEPHRECTOMY ONLY

Year	No. of Cases	Years Survival										Living	
		1	2	3	4	5	6	7	8	9	10		
1930	1	0	0	0	0	0	0	0	0	0	0	0	
1931	1	1	1	1	1	1	1	1	1	1	1	1	July 1941
1932	0	0	0	0	0	0	0	0	0	0	0	0	
1933	0	0	0	0	0	0	0	0	0	0	0	0	
1934	0	0	0	0	0	0	0	0	0			0	
1935	4	3	3	3	3	3	3	3				2	April 1942 and July 1943. One died Nov. 1942
1936	1	1	0	0	0	0	0					0	
1937	1	1	1	1	1	0						0	
1938	3	3	3	3	2							3	Oct. 1941 and 2 in July 1943
1939	2 (1)	0	0	0								0	
1940	4	3	2									2	July 1943
Cases	17	17	17	13	11	8	7	6	2	2	2		
Survival		12	10	8	7	4	4	4	1	1	1		

Figure in parentheses denotes presence of metastases at time of diagnosis.

will be given; below this level, therapy is stopped until the count increases again. It is well to watch the lymphocyte count as well as the total white count, as a drop in lymphocytes is also a danger signal and frequently occurs before the total white count starts to fall. Occasionally the total white count or the lymphocyte count decreases slowly and in this case it may be safe to continue treatment cautiously, but if the drop is rapid, treatment should be stopped completely until the count starts up again. In this event transfusions are of great value.

The temperature should also be checked. If an appreciable fever develops, it is usually advisable to decrease, or even stop, treatments until it subsides somewhat. High temperatures usually indicate a rapid destruction and absorption of tissue, as well as infection. In the presence of infection, large doses of x-rays may be actually harmful.

Radiation sickness is occasionally troublesome. Our patients are urged to drink large quantities of fluids and to lie down and rest soon after each treatment. Sedation may help to alleviate the sickness. Care of the bowels is also an important factor, and patients are instructed in the type of diet which will aid in elimination and are advised to take enemas when necessary. Vitamin B_1 is often given and seems to be of value in many cases.

RESULTS OF TREATMENT OF CARCINOMA OF THE KIDNEY CORTEX

As was stated above, treatment included surgery alone (17 cases), surgery plus irradiation (48 cases), and irradiation alone (13 cases). Three cases received no treatment.

Seventeen cases of proved carcinoma of the renal cortex were treated by nephrectomy only. It should be mentioned here that this represents a rather selected group, as all of the patients were regarded as good surgical risks, without known metastases at the time of diagnosis (with one exception), and it was felt that the entire tumor was removed at surgery. If there was any doubt as to these conditions, the patient was referred for x-ray therapy. It is true, of course, that in many of those referred for irradiation, also, there were no known metastases and the entire tumor was believed to have been removed surgically.

Of the 8 patients treated by nephrectomy only up to the end of 1937, 4 lived five years or more. One, treated in 1935, lived seven years and died in 1942. The other 3 are living and well at the present time, one for ten years and the other 2 for seven years.

Of the 9 patients treated by nephrectomy only since 1937, 3 are living and well at the present time and one was living and well when last heard from in 1941. One of this group was treated in 1938 and has

TABLE IV: FORTY-EIGHT CASES OF PROVED CARCINOMA OF THE RENAL CORTEX TREATED BY X-RAY AND NEPHRECTOMY

Year	No. of Cases	Years Survival										Living	
		1	2	3	4	5	6	7	8	9	10		
1924	1 (*)	1	1	1	1	1	1	1	1	1	1	0	Died April 1941
1925	0	0	0	0	0	0	0	0	0	0	0	0	
1926	1 (*)	1	1	0	0	0	0	0	0	0	0	0	
1927	1 (*)	0	0	0	0	0	0	0	0	0	0	0	
1928	3	2	1	1	1	1	1	1	1	1	1	1	Dismissed from follow-up
1929	2	2	2	2	1	1	1	1	1	1	1	1	Dismissed from follow-up
1930	1 (1)	0	0	0	0	0	0	0	0	0	0	0	
1931	1	0	0	0	0	0	0	0	0	0	0	0	
1932	1	1	1	1	1	0	0	0	0	0	0	0	
1933	3	3	3	1	1	1	1	1	1	1		1	Aug. 1943
1934	5 (1)	4	3	3	3	3	1	1	1			1	July 1943
1935	2	2	1	0	0	0	0	0				0	
1936	7	6	5	4	3	3	3					3	Nov. 1942 and 2 in Aug. 1943
1937	8 (1) (*)	7	4	3	1	1						1	Nov. 1942
1938	5	4	3	3	3							2	Aug. 1943
1939	3	3	2	1								1	Jan. 1943
1940	4	2	1									1	July 1942, with metastases in the spine
Cases	48	48	48	44	41	36	28	21	19	14	11		
Living		38	27	19	15	11	8	5	5	4	3		
Per cent living		79	56	43	37	31	29	24	26	29	27		

Number in parentheses indicates metastases at the time of diagnosis.
Asterisk in parentheses indicates a case in which x-ray therapy was not given to the kidney but was given to metastases later.

actually survived five years, being alive and well in 1943. The other 2 patients were treated in 1940 and are both living and well in 1943.

The results of treatment in this group are shown in Table III.

Forty-eight cases of proved carcinoma of the renal cortex were treated by nephrectomy and irradiation. Thirty-six of these were treated up to and including 1937. In this group, 11 patients (30 per cent) survived five years or more, and 8 are living and well at the present time, 3 of them for ten years or longer.

Metastases were present at the time of diagnosis in 3 of these 36 patients, and all were dead in one year or less.

Four of the 36 patients treated up to the end of 1937 received no irradiation to the kidney area but did receive irradiation to metastases later. One of these lived for seventeen years from the time of surgery, one lived for two years, and the other 2 died in less than one year.

Twenty-four of the 36 cases treated by both nephrectomy and irradiation up to the end of 1937 received immediate postoperative prophylactic x-ray therapy. By this we mean that: (1) the x-ray therapy was given as soon after the nephrectomy as possible, in most cases within one month; (2) no known metastases were present at the time treatment was initiated; (3) the full course of therapy as planned was administered. Of the 24 patients, 10 (42 per cent) survived five years or more after treatment. The results of treatment in this group are shown in Table VI.

Twelve patients with proved carcinoma of the renal cortex have been treated since 1937, of whom 7 are known to be dead. One, last heard from in 1941, had metastases in the lungs; one, last heard from in 1942, had metastases in the spine; and 3 are living and well in 1943. It is probable that the survival rate for this group treated since 1937 will not equal that for patients treated prior to that year, and it is possible that the survival rate of 42 per cent in the earlier group is higher than will be obtained over a longer period with a larger group of patients.

The results in the whole group of adenocarcinoma of the renal cortex treated by nephrectomy and irradiation are shown in Table IV.

TABLE V: THIRTEEN CASES OF PROVED CARCINOMA OF THE RENAL CORTEX TREATED BY IRRADIATION ONLY

Year	No. of Cases	Years Survival					Living	
		1	2	3	4	5		
1926	1 (1)	0	0	0	0	0	0	
1928	1 (1)	1	1	1	1	0	0	
1929	1 (1)	0	0	0	0	0	0	
1932	1 (1)	0	0	0	0	0	0	
1934	5 (5)	2	0	0	0	0	0	
1937	2 (1)	1	1	1	1	1	1	Aug. 1943
1939	2	0	0	0			0	
Cases	13	13	13	13	11	11		
Survival		4	2	2	2	1		

Number in parentheses denotes metastases at time of diagnosis.

TABLE VI: RESULTS OBTAINED IN 34 CASES OF CARCINOMA OF THE RENAL CORTEX TREATED BY NEPHRECTOMY AND IMMEDIATE POSTOPERATIVE PROPHYLACTIC X-RAY THERAPY

Year	No. of Cases	Years Survival										Living	
		1	2	3	4	5	6	7	8	9	10		
1928	3	2	1	1	1	1	1	1	1	1	1	1	Dismissed from follow-up
1929	2	2	2	2	2	1	1	1	1	1	1	1	Dismissed from follow-up
1930	0	0	0	0	0	0	0	0	0	0	0	0	
1931	1	0	0	0	0	0	0	0	0	0	0	0	
1932	0	0	0	0	0	0	0	0	0	0	0	0	
1933	3	3	3	2	1	1	1	1	1	1		1	July 1943
1934	4	4	3	3	3	3	1	1	1			1	July 1943
1935	1	1	1	0	0	0	0	0				0	
1936	6	6	5	3	3	3	3					3	Nov. 1942 and 2 in Aug. 1943
1937	4	4	3	3	2	1						1	Nov. 1942
1938	4	3	3	3	3							2	Aug. 1943
1939	2	2	1	1								1	Jan. 1943
1940	4	3	2									1	July 1942 (now has metastases in spine)
Cases	34	34	34	30	28	24	20	14	13	9	6		
Survival		30	24	18	15	10	7	4	4	3	2		
Per cent survival		88	71	60	55	42	35	29	31	33	33		

Thirteen proved cases of carcinoma of the renal cortex were treated by irradiation alone. Ten patients in this group had metastases at the time of diagnosis and all are dead. One of these lived four years after therapy, 2 lived one year, and 7 died within less than a year. Three of these 13 patients did not have metastases at the time of diagnosis. Surgical exploration in one of these showed the tumor to be inoperable. Another was considered a poor surgical risk and surgery was not done. Both these patients were dead in less than one year. In the third case exploration showed an abscess in the kidney area, which was drained with removal of a large amount of necrotic material. The patient was given postoperative x-ray therapy in December 1937, about 2 months after surgery, and was alive and well with no evidence of disease in August 1943. Table V shows the results obtained in this group treated by irradiation only.

Of all the patients who came to the Clinic before the end of 1937, a total of 58, 17 have survived five years or more, an absolute five-year-survival rate of 29 per cent.

WILMS' TUMOR

(*Embryonal Adenomyosarcoma*)

Thirteen cases of Wilms' tumor were seen at the University Hospitals from 1926 to 1940, inclusive. Five cases were proved by histologic examination and 8 were diagnosed by typical clinical findings, urography, appearance at laparotomy, and response to irradiation. All cases were

followed to the close of the study in 1942, and two of the three living patients were seen in June and July of 1943.

There were 9 males and 4 females in this series. In most of the reported series males predominate over females, although the opposite is sometimes true. The difference does not seem to be of any diagnostic significance.

Twelve of the 13 patients were six years of age or less. The youngest was three months and the oldest eleven years. This is essentially a disease of infants and young children, although cases have been reported in late adult life. Deming (41) is credited with having treated the youngest patient with this lesion, having done a nephrectomy in a 29-day-old infant. MacKenzie and Parkins reported a series of 11 cases, all in children under seven years, and in Kerr's series (15) all were under six years of age.

Abdominal mass, hematuria, and pain are the most common symptoms. An abdominal mass was present in 9 of our 13 cases (69 per cent), being the initial symptom in 5 cases and an associated symptom in 4. It was usually present only a few weeks until the patient was seen at the Hospital, but in 2 cases it had been present for more than a year. In one patient, a 6-year-old girl (Case 8), the mass had been present for a year and a half before she was first seen at the Clinic. She died fourteen months after laparotomy and x-ray therapy, with metastases in both lungs. The other patient was a girl of 18 months (Case 1), in whom the mass had been present for a year and a quarter when first seen. She died three months following nephrectomy and x-ray therapy, with metastases in both lungs. An abdominal mass is almost always present. Kretschmer (30) reported a series of 24 cases in which it was present in all. Kerr states that it is usually present.

Hematuria was present in 4 of the 13 cases (30 per cent), being the initial symptom in one and an associated symptom in 3. This is a somewhat higher incidence than is usually seen. This symptom was present in only one of Kretschmer's 24 cases and in only one of Neff's series of 8. Kerr states that it occurs in from 10 to 25 per cent of the cases.

Pain was present in 4 cases and weight loss in 2. In Kretschmer's series, pain was present in 33 per cent and weight loss in 25 per cent.

In one case (Case 12) fever was the initial symptom and had been present for only two weeks when the patient was first seen at the Hospital. A palpable mass was found five days previously. Irradiation to the kidney area was given, but in spite of the early institution of therapy after the appearance of symptoms, the patient expired two months later with metastases in both lungs.

Known metastases were present at the time of diagnosis in 6 cases, and in each instance the site of metastasis was the lungs. Late metastases occurred in 3 cases, and here, too, the site in each instance was the lungs.

One case (Case 13) presents some especially interesting features.

A 2-year-old girl was admitted to the Hospital in April 1940 with an abdominal mass, abdominal pain, and hematuria of four months' duration. The patient was treated by x-rays only. From April 16 to 27 she was given 650 tissue r to the anterior and the same amount to the posterior right kidney area. From June 5 to 25 the anterior, lateral, and posterior right kidney areas were each given 1,250 tissue r. On Aug. 1 a roentgenogram of the chest revealed metastases in the apex of the left lung, and from Aug. 7 to 22 1,550 tissue r each were administered to anterior, lateral, and posterior left upper chest fields. Another course of therapy was given to the three kidney areas from Aug. 23 to Sept. 14, 1,300 tissue r being given to each field. A re-examination of the chest in February 1941 revealed metastases in the right lower lung field and accordingly 1,300 tissue r each were given to the anterior, lateral, and posterior right lower chest. Repeated roentgen examinations since that time show that the metastases in both of these areas have disappeared following therapy. This patient was alive and well with no evidence of recurrence in July 1943.

Kerr reported a case with pulmonary metastases which disappeared following x-ray therapy. Kretschmer also recorded a case with pulmonary metastases which

TABLE VII: SUMMARY OF 13 CASES OF WILMS' TUMOR

Case No.	Age	Sex	Treatment		Metastases		Living	Dead
			Surgery	Irradiation	At Diagnosis	Late		
Proved Cases								
1	1½ yr.	F	Nephrectomy Sept. 1934	Aug. 1934 Nov. 1934 to abdomen and lungs	Both lungs	...	...	Dec. 1934 (3 months)
2	3 yr.	M	Nephrectomy Jan. 1936	Dec. 1935 March 1936	None	Lungs	...	Sept. 1936 (8 months)
3	1½ yr.	M	Nephrectomy Dec. 1938	Oct. 1938 Jan. 1939	None	None	June 1943 4 years	....
4	3 mo.	M	Nephrectomy Sept. 1940	Sept. 1940 (postop.)	None	None	Oct. 1942 2 years	....
5	4 yr.	M	None	Oct. 1940 to abdomen and lungs	Both lungs	None	...	Jan. 1941 (3 months)
Unproved Cases								
6	6 yr.	M	Laparotomy Sept. 1926	Aug. 1926 Dec. 1926	Questionable to liver	None	...	Oct. 1930 (4 years)
7	11 yr.	F	None	Nov. 1929 March 1930	Both lungs	...	...	April 1930 (5 months)
8	6 yr.	F	Laparotomy Jan. 1931	Jan. 1931 April 1931 June 1931	.....	Both lungs	...	March 1932 (14 months)
9	6 yr.	M	None	To abdominal mass Oct. 1931 and Feb. 1932 To both lungs Nov. 1931	Both lungs	...	...	May 1932 (7 months)
10	3 yr.	M	None	March 1936	Both lungs	...	...	June 1936 (3 months)
11	9 mo.	M	None	April 1938 Aug. 1938	None	None	...	Feb. 1939 (10 months)
12	3 yr.	M	None	Oct. 1939	Both lungs	...	...	Dec. 1939 (2 months)
13	2 yr.	F	None	April 1940 and Aug. 1940 to abdominal mass Rt. lung Aug. 1940 Lt. lung Feb. 1941	.....	Both lungs	July 1943 ...	.....

disappeared following x-ray therapy, but in which, at autopsy, many deposits were found throughout both lung fields (31).

It seems that radiation therapy to metastases may be of considerable value, and Kerr, Dean, Bothe, and others recommend its use.

Table VII gives a brief outline of our 13 cases of Wilms' tumor. It will be seen that 9 of the patients died within fourteen months after therapy and one 4 years after laparotomy and x-ray therapy. Three patients are living and well, one for two years, one for three years, in July 1943, and one for four years and eight months in June 1943. These 3 cases were treated by different methods, the first by nephrectomy and postoperative x-ray therapy, the second by x-ray therapy only, and the third by preoperative and postoperative x-ray therapy and nephrectomy.

It seems to be rather generally agreed that x-ray therapy is more useful in the treatment of Wilms' tumor than in any other malignant renal neoplasm. Dean states that in his few personal cases irradiation alone has given results as good as or better than irradiation plus surgery. He feels that surgery alone is practically of no benefit. Pohle and Ritchie (42) reported a case with a survival of three years and eight months after x-ray therapy only and McNeill and Chilko (28) had a patient living and well three years after x-ray therapy only. Mixter (37), Wade (40), and Ladd and White (47), on the other hand, believe that early nephrectomy offers the only hope of cure. Ladd and

White reviewed the literature and added a series of 60 cases of their own with results strongly favoring surgery in the treatment of this tumor. In their group of 60 cases they had 8 five-year survivals and 6 other patients were living two to four years after therapy; in this group of 14 cases, only 1 had received x-ray therapy. (The writers did not state how many of the entire group of 60 cases had received irradiation.) Nephrectomy was done in all 14 cases.

Some authors prefer preoperative x-ray therapy and nephrectomy (15, 32, 33). The reduction in tumor size which invariably follows irradiation greatly facilitates nephrectomy. Others (3, 16, 30) follow this with postoperative x-ray therapy. We are of the opinion that both preoperative and postoperative irradiation ought to be used, but statistical proof of their value is so far lacking. The results seem to be poor regardless of the type of therapy.

The radiation therapy in this group was administered with the same equipment that was used for the tumors of the cortex. Treatment was administered to an anterior and posterior field, and in some cases a lateral field was added. The usual daily dose was 200 r/air to one field. The amount varied somewhat but in general was about 1,500 tissue r per field and in several of the cases the course of therapy was repeated. In the average case this delivered between 2,500 and 3,000 tissue r to the tumor. Nephrectomy was performed in 4 of these cases, and 3 of them received preoperative and postoperative x-ray therapy. Two patients died in less than one year and one is living and well in June 1943, four years and eight months after therapy. One patient in whom nephrectomy was done received only post operative irradiation and was living and well in October 1942, two years after therapy. Kerr gives 200 r/air per day to one of 3 ports until 3,000 to 4,000 r/air have been delivered to each port. Dean (3) states that if x-ray alone is to be used, "daily treatments of 75 r to 100 r should be given to one of 3 ports until 3,000 r has been applied to each;" if therapy is to be preoperative, with the intention of decreasing the size of the tumor, "200 r can be given to a single portal (of 3 to be used) daily." After two cycles, if the radiation is well tolerated the daily dose can be reduced to 100 r. After nephrectomy has been performed, "100 r is given a portal daily until 2,000 r has been received by each of 3 portals." In the average child, this gives about 7 T.E.D. to the pedicle of the tumor.

The prognosis in this lesion is very poor. MacKenzie (39) places the mortality at 98 per cent, while Hyman, Kerr, and McNeill and Chilko all place it at above 90 per cent. Bothe reported a series of 7 patients, all dead within three and a half years. Mixter (37), however, believes the outlook after two years' cure is better with Wilms' tumor than with any other malignant renal neoplasms. The results of treatment in some of the reported series are as follows:

1. Kretschmer: 7 patients; 5 dead in 1 1/2 years or less; 2 living 2 1/2 and 3 1/2 years.
2. Mixter: 26 of 27 patients dead in less than 18 months.
3. Wollstein: 4 of 18 patients lived 10 years.
4. Schippers: 4 of 145 patients living 4 years.
5. Hyman: 94 per cent dead in less than 5 years.
6. MacKenzie and Parkins: 13 patients; 11 dead; 2 living 7 and 2 years.
7. Kerr: 14 patients; 12 dead in less than 4 years; 2 living 59 and 52 months.
8. Geschickter and Widenhorn: 25 cases with no 5-year survivals.
9. Bothe: 7 patients, all dead in 3 1/2 years or less.
10. Dean and Pack: 16 patients; 13 dead and 3 lost from follow-up.
11. Priestley and Broders: 65 patients, of whom 40 were followed; 36 dead; 1 living 13 years, 1 living 3 years, and 2 living 5 months.
12. Ladd and White: 60 cases; 8 5-year survivals; 6 patients living 2 to 4 years.

Authors' series: 10 of 13 patients dead in 4 years or less (9 in 14 months or less); 3 living, 1 for 4 years and 8 months, 1 for 3 years, and 1 for 2 years.

Eight of the authors' 13 cases have not been proved histologically, but the symptoms were so characteristic, as well as the

TABLE VIII: SUMMARY OF 9 CASES OF CARCINOMA OF THE KIDNEY PELVIS

Case No.	Age	Sex	Treatment		Results
			Surgery	Irradiation	
Proved Cases					
1	56	M	Nephro-ureterectomy with coagulation of intramural portion of bladder Jan. 1934	Preop. Aug. 1933	Living and well Aug. 1940, 7 years after start of therapy
2	55	M	Nephrectomy Oct. 1934 Ureterectomy Dec. 1934	Postop. Dec. 1934 Sept. 1935	Died Feb. 1936. Late metastasis to axilla, surgical scar, and chest. Survived 16 mo.
3	39	M	Nephro-ureterectomy Feb. 1935 Partial cystectomy July 1935	Postop. July 1935 Sept. 1935	Living and well when last heard from in 1937. Lost from follow-up
4	59	M	Nephrectomy Feb. 1935	None	Died May 1935. Survived 3 mo.
5	68	M	Nephrectomy Oct. 1935 Ureterectomy Dec. 1935	Postop. Oct. 1935	Died June 1936. Survived 8 mo.
6	71	M	Intracapsular nephrectomy April 1937	Postop. May 1937	Lost from follow-up
7	48	M	Nephrectomy Aug. 1939	Postop. Aug. 1939	Living and well Dec. 1942, 3 yr. 4 mo. after therapy
Unproved Cases					
8	40	F	Attempted nephrectomy Aug. 1934. Tumor not removed because of bleeding	Postop. Nov. 1934	Died Aug. 1935, one year after surgery
9	49	M	Laparotomy May 1937. Tumor not removed because of extension into surrounding structures	Postop. Aug. 1937 Jan. 1939 Sept. 1941	Died Feb. 1943. Survived 5 yr. 9 mo. after start of therapy

gross appearance in 2 cases at laparotomy and the response to irradiation, that the diagnosis can hardly be doubted.

CARCINOMA OF THE KIDNEY PELVIS

Nine cases of carcinoma of the kidney pelvis were treated at the University Hospitals from 1934 to 1940, inclusive. Seven cases are proved histologically, and 2 are unproved cases diagnosed by clinical symptoms, urography, and appearance on exploratory surgery. Eight patients of this group were males. Males usually predominate; in Priestley's series the ratio was three to one. The youngest patient was 39 and the oldest was 71. The average age was 54 years.

Hematuria was the most frequent symptom, occurring in 7 of the 9 cases. It was the initial symptom in 2 cases and an associated symptom in 5 cases. The longest duration of hematuria before admission was three years; incidentally, this patient was known to be alive and well seven years after preoperative x-ray therapy and nephrectomy. Hematuria is a very common symptom in carcinoma of the renal pelvis. It was present in 100 per cent of Waters' series. Portmann does not give any figures, but states that it is an almost constant symptom.

Four patients complained of pain in the flank and 3 of pain in the back. Because tumors of the renal pelvis tend to cause obstruction and infection more than tumors of the parenchyma, pain is a relatively common symptom. Weakness and weight loss were present in 3 cases.

Seven of the 9 patients were followed until the close of the study. Of the other 2, one was followed for two years and then lost from follow-up and one was lost immediately after discharge. Two of the patients are living and well at the present time, one after seven years and one after three years. One patient died in February 1943, five years and nine months after laparotomy and x-ray therapy. Table VIII gives a brief summary of these cases.

The radiation therapy was administered to the tumors of the renal pelvis in the same manner and amount, and with the same precautions, as to the cortical tumors.

TABLE IX: RESULTS OF TREATMENT OF MALIGNANT TUMORS OF THE KIDNEY

Author	Five-Year Survival	Treatment
1. Hunt and Hager	18%	Nephrectomy and some x-ray therapy
2. MacKenzie and Parkins	16%	Nephrectomy and x-ray therapy
3. Beer	34%	Nephrectomy (no statement as to x-ray)
4. Walters	43% 17%	Nephrectomy and postoperative x-ray X-ray and radium only
5. Mintz and Gaul	11% (1900–23) 16% (1924–35)	Mostly surgery Mostly surgery
6. Priestley	38%	Nephrectomy and some x-ray therapy
7. Hyman	15%	Nephrectomy and x-ray therapy
8. Braasch	10%	
9. Neff	15%	Nephrectomy. No x-ray therapy
10. Judd and Hand	26%	Surgery and some x-ray therapy
11. Chute	15%	Nephrectomy. No x-ray therapy
12. Israel	34 cases—18 deaths from metastases in 2 years	
13. Garceau	43 cases—39 deaths from metastases in 3 years	
14. Cunningham	31 cases—22 deaths from metastases in 3 years	

In some of the cases, because of the tendency for tumors of the pelvis to implantation along the course of the ureter, the fields were extended to include the ureter of the involved side.

Carcinoma of the renal pelvis is a radioresistant tumor. Bothe has pointed out that many of the cellular characteristics of this lesion are antagonistic to radiation therapy, which he feels is of palliative value only. Waters and Lewis (20), Waters (37), and Munger (19) all found this tumor to be radioresistant. For this reason many investigators recommend x-ray therapy only if there is extension outside of the renal capsule (8, 17, 35). Priestley states that in his series x-ray therapy has not been shown to be of any value.

There is a strong tendency in carcinoma of the renal pelvis for the occurrence of malignant implantations along the course of the ureter and in the bladder. For this reason, a complete nephro-ureterectomy, including a cuff of bladder at the ureteral orifice, is the operation of choice. This has been the procedure at the University Hospitals for the past several years and is advocated also by Dean, who believes that the tumor is not infrequently confined to the urinary tract. O'Conor (17) believes that the survival rate in this lesion will probably continue to improve because of the increasing use of this type of operation. Frequent cystoscopic examinations of the bladder are indicated in order that malignant implantations may be found as quickly as possible. If the lesion is limited to the renal pelvis, metastases do not develop (35).

AUTHORS' SERIES

(Treated up to and including 1937)

	No. of Cases	Five-Year Survivals	Per Cent Five-Year Survivals
Carcinoma of the renal cortex			
1. All cases admitted and proved (absolute survival rate)	58	17	29
2. Cases receiving immediate postoperative prophylactic x-ray therapy	24	10	42
Carcinoma of renal pelvis	6	1	16
Wilms' tumor	2	0	0
All malignant renal tumors	66	18	27

The results of treatment in this tumor are poor. Gilbert and MacMillan reported a series of 55 cases with no five-year survivals. MacKenzie and Parkins reported a 13 per cent five-year survival. In our 6 proved cases treated before the end of 1937, there was one survival for more than five years (16 per cent).

CONCLUSIONS

1. In spite of improvements in methods of treatment, the mortality from malignant lesions of the kidney remains high.

2. Apparently the greatest obstacle to the reduction of this high mortality rate is the advanced stage of the lesion in most cases when first seen.

3. Hematuria is the symptom most likely to bring the patient to the physician in time to make possible an early diagnosis. Every patient, therefore, with unexplained hematuria should be given a thorough urological investigation.

4. Nephrectomy is the treatment of choice for malignant tumors of the kidney, with the possible exception of Wilms' tumor. In Wilms' tumor irradiation seems to be of greater value than in any other malignant renal neoplasm and should constitute an important part of the therapy. We feel that, if surgery is used, it should be in conjunction with preoperative and postoperative irradiation.

5. X-ray therapy is a valuable adjunct to surgery, (1) facilitating nephrectomy in many cases by reducing the size of the tumor; (2) perhaps rendering malignant cells dormant and reducing the danger of metastasis from manipulation at surgery; (3) inhibiting the growth of malignant cells which may be left behind.

6. In cases not suitable for surgery and without metastases, x-ray therapy may be valuable in prolonging life and affording palliation.

7. X-ray therapy is of value in the treatment of late metastases and recurrences. Life may or may not be prolonged, but relief of pain is frequently obtained.

SUMMARY

1. An analysis has been made of 117 malignant renal neoplasms seen at the University of Minnesota Hospitals from 1924 to 1940, inclusive. This group is made up of 94 adenocarcinomas of the cortex (81 proved histologically), 13 Wilms' tumors (5 proved), 9 carcinomas of the renal pelvis (7 proved), and one proved sarcoma.

2. A classification of renal tumors, both malignant and benign, previously published by Bell, has been included and used in this report.

3. The clinical picture of renal cancer, as brought out by these cases, has been presented, with a brief discussion of the more common symptoms.

4. Therapy consisted of surgery alone (17 cases), surgery plus irradiation (48 cases), and irradiation alone (13 cases). The technic of the roentgen therapy used in these cases is discussed.

5. The results of therapy in these cases have been presented, only those cases proved by histological study being used in compiling the survival rates.

In adenocarcinoma of the cortex, the five-year survival rate for cases treated by surgery alone is 50 per cent; by surgery plus irradiation 31 per cent; by surgery plus immediate postoperative irradiation 42 per cent; by irradiation alone 8 per cent (77 per cent had metastases at the time of diagnosis).

In the Wilms' tumor group there were no five-year survivals. Three patients, however, are still living and well with no evidence of disease, the longest for four years and eight months.

For carcinoma of the pelvis, the five-year survival rate is 16 per cent. The five-year survival rate for the entire series of kidney tumors (proved histologically) is 27 per cent.

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The Diagnostic Value of Pneumoperitoneum[1]

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THE USEFULNESS of pneumoperitoneum in roentgenologic diagnosis has never been given the attention that it deserves, though many scientific papers regarding it have been published since Stewart and Stein (36) first popularized it in this country in 1919. Hinkel (19), Lewis (24), Sante (30), Thaxter (37), Stein (33–35), Rubin (29), and others have given us the early history of the procedure and advocated its use as a diagnostic measure. In spite of their excellent papers, however, there is still some hesitancy in its application.

Pneumoperitoneum is the presence of free gas in the peritoneal cavity. It may occur spontaneously or may be induced. Spontaneous pneumoperitoneum is usually the result of perforation of a hollow viscus at the point of a pathological change. The most frequent causes of perforation are penetrating peptic ulcer, carcinoma of the gastro-intestinal tract, infection of the bowel due to typhoid fever or tuberculosis, rupture of a distended loop of bowel following a partial or complete obstruction, and rupture of the bowel or diaphragm as the result of trauma. Balch (2) reports a case of pneumoperitoneum due to perforation of the transverse colon associated with a strangulated umbilical hernia.

Pneumoperitoneum can be brought about artificially in several ways. Rubin (29) has pointed out that it can easily be induced by intra-uterine insufflation when the tubes are patent. Banyai (3), Gaetan (16), and others have shown that pneumoperitoneum is occasionally produced during pneumothorax treatment for tuberculosis. The passage of the needle through the pleural cavity and diaphragm allows the gas to enter and inflate the peritoneal cavity. Schiff, Stevens, and Goodman (32) state that pneumoperitoneum may occur after laparotomy and advise that this be borne in mind when patients complain postoperatively of pain in the shoulder, a feeling of fullness under the sternum, or pain in the chest. Though pulmonary infarct should not be overlooked as a possible cause of such symptoms, pneumoperitoneum can produce an identical syndrome. Induced pneumoperitoneum for diagnostic purposes is accomplished by the injection of gas through a needle or trocar inserted through the abdominal wall, as will be described later.

In addition to its diagnostic value, pneumoperitoneum is an excellent method of treatment in certain diseases. This phase is adequately covered by Banyai (4–10), Barnes (11), Burge (12), Fowler (15), Harper and Levin (17), Harrell (18), Warring and Thomas (39), and others, and will not be discussed in this paper.

The significance of spontaneous pneumoperitoneum in the diagnosis of perforation of peptic ulcer is widely recognized. The percentage of patients giving positive evidence of free gas in the peritoneal cavity varies in the many reported groups of cases, but the general average is accepted as from 75 to 80 per cent. It is generally agreed that the diagnosis of a ruptured peptic ulcer should be made as early as possible and that operation should be immediately undertaken. The amount of air present in the peritoneal cavity does not indicate the duration of the perforation, since in many instances a large amount of gas passes immediately into the peritoneal cavity, while in other cases practically none can be shown at any time.

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Johnson (22) believes that examination should be done as soon as possible after perforation, since he feels that the air present is soon reabsorbed. This, however, is an erroneous impression, since pneumoperitoneum produced by air will continue for days (31). It is important to remember that the amount of free gas in the peritoneal cavity is a definite indication as to the prognosis of the case, since the presence of large amounts of gas and much fluid greatly increases the mortality rate even with prompt operative procedures. There have, however, been reports of spontaneous pneumoperitoneum without evidence of peritonitis, and Hinkel (19) recorded one case in which there was no demonstrable visceral perforation or other disease. The authors have recently seen a patient with a spontaneous pneumoperitoneum discovered at fluoroscopy during the course of a routine gastrointestinal study. He gave a typical history of peptic ulcer of several months' duration. Five days before the fluoroscopic examination he had an attack of acute indigestion lasting for a period of several hours. Though he was hospitalized at that time, no x-ray examination was requested. He felt fine the day after the attack and had no further complaint of pain and showed no evidence of peritonitis. He was ambulatory at the time of the examination, although there were several hundred cubic centimeters of gas in the peritoneal cavity. A duodenal ulcer was demonstrated roentgenoscopically.

Rigler (27) has recently pointed out the necessity for frequent examinations of the patient with intestinal infection and obstruction and has emphasized that pneumoperitoneum can be diagnosed in roentgenograms made in the supine position. The importance of obtaining films of the best technical quality in any radiographic procedure cannot be overstressed, but this is particularly true of investigation of soft-tissue structures in the abdomen. The diagnosis of spontaneous pneumoperitoneum from scout films of the abdomen frequently taxes the ability of the radiologist, and in any questionable case additional views in upright and lateral decubitus positions should be made.

We believe that the contraindications to induced pneumoperitoneum have been overemphasized. We feel that there is no danger from gas embolism when carbon dioxide is used and no great danger with oxygen. Definite cardiac insufficiency, in which the additional load imposed on the heart by the elevation of the diaphragm might prove disastrous, and an acute infection, which might be aggravated by the procedure, seem to us to be the only real contraindications. We have used pneumoperitoneum in chronic peritonitis, chronic bacterial endocarditis, subdiaphragmatic abscess, and pelvic inflammatory diseases without any evidence of activation of the disease process. We have no hesitancy in performing it in any patient whose symptoms call for more diagnostic information than is obtainable by other methods of examination, so long as there is no cardiac insufficiency or acute infection. The oldest patient in whom we have done a pneumoperitoneum study was 86 years of age and the youngest 2 months. In many instances we have found the use of an additional contrast material, such as barium or diodrast, at the time the pneumoperitoneum is done, to be of value. This was of great help in a case in which a large renal tumor was suspected. By the use of diodrast, normal kidney function could be demonstrated and it was evident that the mass was a retroperitoneal tumor not attached to the kidney.

Induced pneumoperitoneum is to be used in conjunction with and not in competition with other methods of diagnosis. Many times it will furnish confirmatory evidence of clinical findings; on the other hand, it may refute a previous clinical diagnosis. Induced pneumoperitoneum enables the radiologist to study the size, shape, and position of the abdominal and pelvic viscera; to determine the presence, location, extent, or absence of abdominal adhesions; to establish the location of masses present in the abdomen or retroper-

itoneal regions; to gain information regarding the presence and extent of peritoneal implants; to establish the location of a lesion as being above or below the diaphragm; and to identify an intrauterine or abdominal pregnancy.

The production of pneumoperitoneum is a simple and relatively harmless procedure. It has been done many hundreds of times throughout the country with few untoward effects since Alvarez (1) introduced the use of carbon dioxide in 1921. Carbon dioxide is readily available, has the advantage of being rapidly absorbed, and produces discomfort for only a few minutes. The use of oxygen or air prolongs the period of discomfort for many hours and offers no advantage over carbon dioxide as a diagnostic procedure, except in patients with massive ascites or those who are difficult to move, making rapid filming impossible. When paracentesis has been done, the use of air or oxygen produces no additional discomfort, while in patients difficult to move, the carbon dioxide is frequently absorbed before the filming is complete and two or three fillings are required to complete the examination. In such instances, it is better to use oxygen and, when the examination is complete, deflate the abdomen by reinsertion of the needle if discomfort occurs.

We claim no originality for the apparatus here described but point out its simplicity and easy availability. It can be readily obtained from any hospital supply room and the hospital carpenter can quickly fashion a mounting board. Two 1,000-c.c. infusion bottles are joined together at the bottom by a rubber tube at least 4 ft. long. One of the bottles (No. 1) is fitted with a two-way rubber stopper and glass tubes, one of the outlets being connected to the tube which goes to a 1,000-c.c. flask containing 200 c.c. of 5 per cent phenol, through which the carbon dioxide (or oxygen) is bubbled, and the other outlet to a rubber tube which will go to the patient. This bottle (No. 1) is now filled with sterile water. The tube to the patient is closed by a clamp. The carbon dioxide is allowed to flow and displace the water from infusion bottle No. 1 to infusion bottle No. 2, thus being accurately measured by water displacement. When about 1,000 c.c. of water have been displaced, the gas is ready for injection. The needle or trocar is inserted into the peritoneal cavity through the abdominal wall about 1 inch below and 1 inch to the left of the umbilicus, which is the site agreed upon by most workers as the logical one for the purpose. Here there is little chance of puncturing a vital organ and the absence of adhesive processes is notable, even in the presence of extensive peritonitis. Lewis (24) uses the linea alba below the umbilicus in order to avoid any anomalous vessels in the abdominal wall. When ascites is present, we advise paracentesis immediately before injection of gas for pneumoperitoneum. The tube from the apparatus is connected to the needle or trocar after its insertion, and the clamp is opened. The injection of the gas is then accomplished by elevating infusion bottle No. 2, containing the water, thus using water pressure alone to inject the gas.

We inject from 1,500 to 2,000 c.c. of carbon dioxide in the average adult, though we have used as much as 5,000 c.c. If there is a massive ascites, the removal of the fluid will make it possible to introduce a much larger amount of gas into the abdominal cavity with little or no discomfort to the patient. In infants we use from 250 to 500 c.c.

After pneumoperitoneum is induced with carbon dioxide, it is important to make the radiographs as rapidly as possible. These are made at 30 inches distance, using cassettes with par speed screens. The technical factors are the same as for radiography of the chest. No grid or Bucky diaphragm is used. Our procedure is as follows: The radiographic tube is positioned so that the principal beam of x-ray will be parallel with the table top and centered at a point midway between the 12th rib and the crest of the ilium. With the tube in this position the cassette

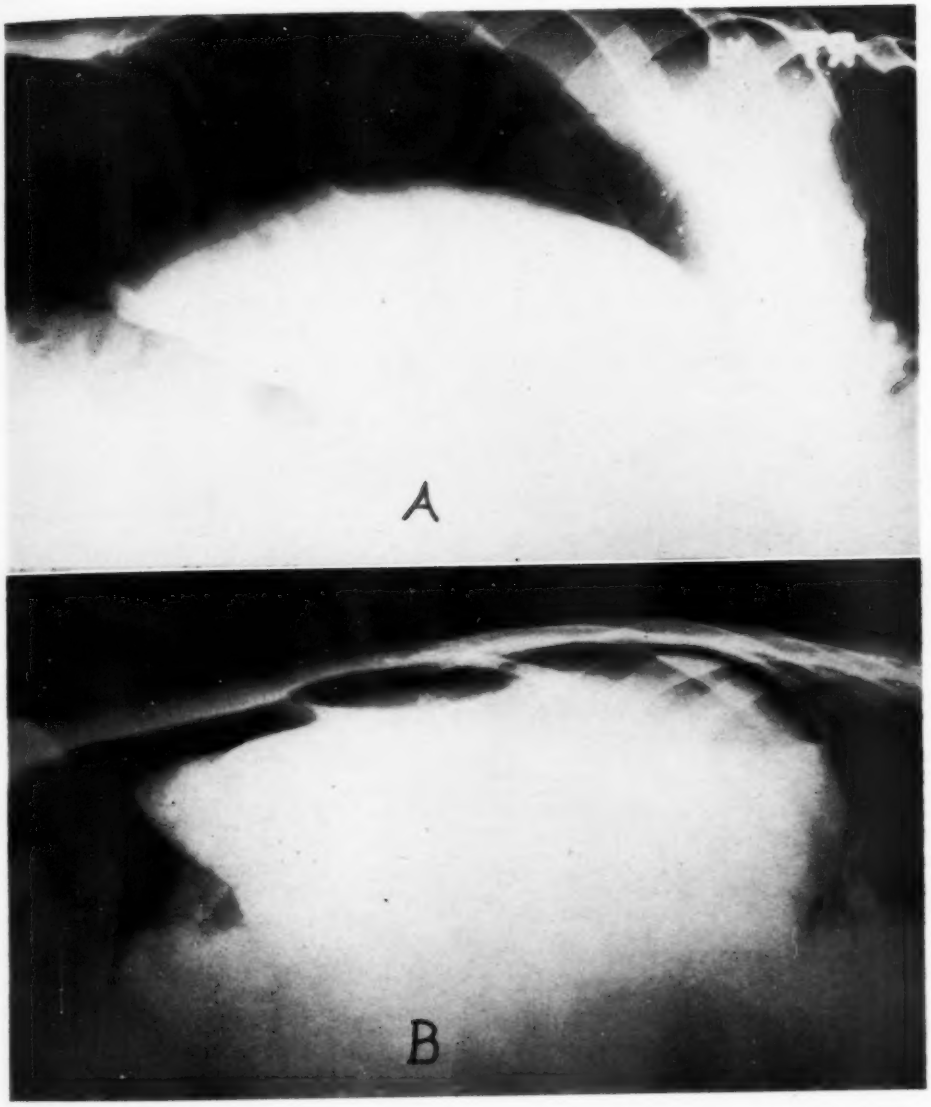

Fig. 1. A. There is a lesion in the pleural cavity above the diaphragm. The liver falls free from the wall of the abdominal cavity. There are no perihepatic or subphrenic adhesions. Note the digitations of the abdominal surface of the diaphragm.

B. There is a subphrenic abscess present with multiple subphrenic and perihepatic adhesions and with multiple fluid levels in the pockets of the abscess.

is placed at a right angle to the table. The first film is exposed with the patient supine on the table. The patient is then rotated into the right lateral decubitus position and a second film is exposed. The patient is then placed in the prone position with pillows under the chest and groins so that the abdomen hangs free and does not bear the weight of the body. This allows a better investigation of the retroperitoneal space. A film having been exposed in this position, the patient is rotated into the left lateral decubitus position and another radiograph is made.

The radiographic tube is now positioned above the table and the patient is placed in the prone position. The table is then put into the Trendelenburg position. The x-ray beam is inclined in a cephalad direction through the pelvis, and a radiograph is made to outline the pelvic viscera. The patient remains prone on the table and the next film is exposed after the head of the table has been raised to an angle of 60° above the horizontal. This completes the radiography. When carbon dioxide is used, it is necessary, as stated above, that radiographs be made as rapidly as possible. If they are not technically satisfactory, additional gas will probably have to be injected, since the rate of absorption of carbon dioxide is too great to permit a repeat series.

By establishing a routine procedure for the examination, the radiologist will be better able to recognize early changes from the normal. We have found that stereoscopic projections do not greatly enhance the diagnostic value of the radiographs.

The usefulness of the procedure, as we have employed it, can best be illustrated by specific examples. Figure 1 shows two cases with an almost identical clinical course. It could not be determined from physical examination whether the pathological change in these patients was above or below the diaphragm. With the aid of pneumoperitoneum it is shown very definitely that the lesion in A is above the diaphragm, while that in B is below the diaphragm.

The size and contour of the liver and spleen are frequently diagnostic aids. Many times, however, it is impossible to establish these definitely from the physical examination, due to the thickness of the abdominal wall or its spasticity (voluntary or involuntary) or to the limitation of palpation because of the pain produced thereby. Frequently, also, erroneous impressions are gained from palpation. On two occasions in our series the diagnosis of an enlarged liver was shown to be wrong. One patient was a white male with a large mesenteric cyst which measured approximately 5 cm. in diameter and was partially calcified. It was attached by adhesions to the lower border of the liver and to the mesentery. The cyst moved with respiration and on palpation felt like an accessory lobe of the liver or a nodular mass protruding from that organ. The second patient was a colored male who had a large mass in the region of the liver and several other palpable masses in the abdomen, but no jaundice and no symptoms indicating any liver damage. He had been operated on about eight years before, for intestinal obstruction, at which time a neurinoma was removed and a portion of bowel resected. He was then symptom-free for six years, after which his abdomen began to enlarge. The masses appeared to be rather firm and nodular. One, anterior to the surface of the liver, gave the impression that the organ was greatly enlarged. A transverse view, with the aid of pneumoperitoneum, showed definitely, however, that there was a normal liver beneath the mass (Fig. 2). The abdominal tumors are believed to be recurrences from the neurinoma, which is a type of tumor tending to recur locally and not to metastasize widely.

Martin (25) has shown there is a definite relationship between the size of the liver and spleen in various diseases and that important information can be obtained from pneumoperitoneum studies of these organs. The very large liver should always suggest the possibility of carcinoma. Enlargement of the liver occurs also in such diseases as leukemia, Hodgkin's disease, syphilis, amyloidosis, and long-standing suppurative infection. Cirrhosis of the liver may also produce enlargement if there has been an attempt at regeneration of liver tissue with a compensatory hypertrophy. A malignant tumor produces a nodular liver which is hard to distinguish from the hobnail liver of cirrhosis except for the size. Metastatic melanoma produces the greatest enlargement of the liver of any type of disease. The difficulty in differentiating between a neoplasm of the

Fig. 2. Large tumor anterior to the liver and attached to it by adhesions. The liver can be identified beneath the mass.

liver and cirrhosis is due to the fact that frequently the latter produces some nodulation as a result of fibrosis with subsequent enlargement due to regeneration of liver tissue, producing an appearance quite like that of cancer. In such instances the size of the spleen is of diagnostic importance.

Very small livers are frequently discovered only with the aid of pneumoperitoneum, although their presence may be strongly suspected from clinical findings. The small, smooth liver of an acute yellow atrophy is readily distinguishable from the small, nodular liver of chronic cirrhosis. The size of the spleen is also an important factor in the differentiation between acute yellow atrophy and atrophic cirrhosis, since it is usually normal in size in acute yellow atrophy and considerably enlarged in atrophic cirrhosis.

The position and size of the spleen are of importance in determining the operability of certain of the familial hemolytic anemias. The presence or absence of adhesions can be established. Martin (25) has given a comprehensive description of the spleen in many of the diseases causing splenomegaly. He points out that the most common cause of a greatly enlarged spleen is leukemia, though subacute bacterial endocarditis, cirrhosis of the liver, and Hodgkin's disease must all be considered in the presence of splenomegaly. A large, smooth spleen is found in chronic malaria, which is rather prevalent in the southern states. The similarity in the appearance of the spleen in leukemia, familial hemolytic jaundice, acute bacterial endocarditis, etc., makes their diagnosis impossible from study of that organ alone.

The diagnosis of tumors in the mid-portion of the abdomen is difficult but can be accomplished in many instances. Early diagnosis of tumors in the head of the pancreas will give the patient a better chance for palliation and possible cure. In one of our patients a diagnosis of tumor of the head of the pancreas without evidence of liver metastases was made.

Fig. 3. Postoperative tent-like adhesions are readily demonstrable on this radiograph.

At operation the pancreatic tumor was not resectable. Complete obstruction of the common bile duct necessitated a cholecdochoduodenostomy. Weak radium needles were placed in the tumor with threads leading out of the abdomen through a cigarette drain. High-voltage x-ray therapy was also applied while the needles were in place. The patient is now at work and symptom-free, except for a ventral hernia, fourteen months after operation. There has been no recurrence of the ascites. The previously palpable mass can no longer be felt. Such palliation is certainly worth while.

The recognition of certain types of infection and adhesions in the peritoneal cavity is also of great value. Tuberculous peritonitis is clearly shown in most instances but is usually diagnosed before resort to pneumoperitoneum. The usefulness of the procedure in this disease is limited to the determination of its extent and the amount of involvement in the peritoneal cavity and as a therapeutic procedure. In one case in our series the diagnosis of peritonitis was made only following pneumoperitoneum, since the chief complaint had been in the chest. The presence of a low-grade peritonitis was not suspected. This condition had caused the omentum to adhere to a large area of the anterior abdominal wall. There were also many thick abdominal adhesions.

Pneumoperitoneum is the only accurate method of determining the presence, location, and extent of peritoneal adhesions. The gas brings the adhesions into clear relief. Postoperative tent-like adhesions are shown in Figure 3.

In one of the cases in our series the clinician felt a mass in the abdomen which he believed to be a retroperitoneal tumor. Pneumoperitoneum examination, however, showed it to be in the anterior abdomen, closely associated with the abdominal viscera. A diagnosis of mesenteric tumor was made and confirmed at operation. The pathological report showed it to be a sarcoma.

The recognition of pelvic viscera is usually possible, although occasionally there are multiple adhesions in the pelvis and very little gas can be forced into it. The patient should be catheterized or should empty the bladder immediately before

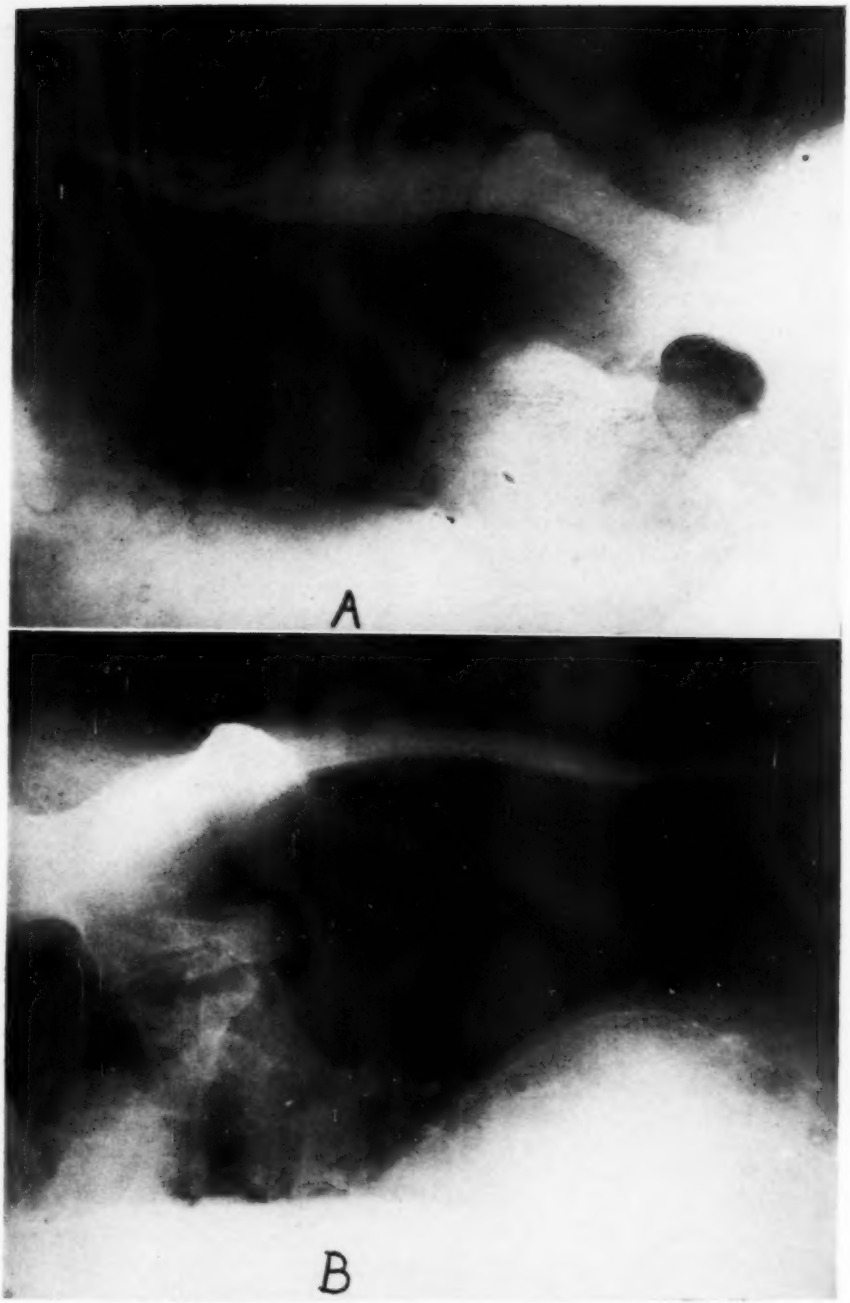

Fig. 4. The enlarged ovaries in these two cases are quite similar in appearance. The films show that they were not adherent to other structures at the time of examination.

the induction of pneumoperitoneum. Figure 4 shows the similarity between tumors of the ovary. In each of these cases there was a large, rounded, freely movable mass in the region of the ovary, with no evidence of peritoneal metastases. Operation in one of these cases has resulted in a three-year survival without evidence of recurrence, although the ovary removed was carcinomatous. The second patient was not operated upon and no follow-up examination has been possible.

The use of pneumoperitoneum in determining traumatic rupture of the urinary bladder has been advocated by Vaughan and Rudnick (38). They believe that the injection of gas into the bladder by catheter is the safest method. If the rupture is into the abdominal cavity, a pneumoperitoneum is produced, which can be readily recognized. If the rupture is extraperitoneal, the extravasation of gas in tissue is quite evident.

Stein (33–35), Mathieu (26), and others have pointed out the value of pneumoperitoneum in pregnancy. An intrauterine pregnancy is easily identified; it is also quite simple to identify an ectopic pregnancy. The pneumoperitoneum should be induced by abdominal puncture and should not be attempted by transuterine insufflation. There should be no hesitancy in utilizing pneumoperitoneum as an additional aid in the diagnosis of suspected tubal or abdominal pregnancy.

Pneumoperitoneum is also used, as pointed out by Faulkner (14), in the investigation of the diaphragm. It may be employed in conjunction with pneumothorax or in cases where pneumothorax is not possible due to pleural adhesions.

Sante (31) has shown that there is a very definite place in the field of radiation therapy for the use of pneumoperitoneum. This permits the removal of the intestines from the field of irradiation. It also allows an accurate investigation of the size, shape, and position of the uterus and adnexa and can be utilized in the determination of the x-ray portals so that the maximum intensity of the beam is directed to the location of the tumor to be treated. The technic of this procedure is well presented in his paper and does not need to be repeated here.

SUMMARY

Pneumoperitoneum is a valuable diagnostic procedure to be used in conjunction with other methods of examination. The necessary apparatus is available in any radiographic department, and the procedure entails little additional expense and effort. Properly carried out, it is without serious danger to the patient and frequently yields vital information.

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Responsibility of the Roentgenologist in the Wartime Duodenal Ulcer Problem[1]

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MY INTEREST IN the wartime problem of duodenal ulcer lies in the fact that the Selective Service regulations place the responsibility for the diagnosis of peptic ulcer upon the roentgenologist. There are many phases in the life cycle of an ulcer of the duodenum which present perplexing problems roentgenologically. There are also differences of opinion among roentgenologists and gastroenterologists concerning the roentgen criteria in the varying early developmental phases of the disease. It seems opportune, therefore, to clarify certain conceptions regarding the roentgen signs of the different stages of duodenal ulceration.

Although the roentgen diagnosis of duodenal ulcer is best established on anatomic findings, these changes are not always demonstrable. One must remember that the roentgen portrayal of a duodenal ulcer deformity depends upon the stage of development of the ulcer at the time of the examination and that it is not constant in all cases. Because of the protean character of the roentgen phenomena the roentgenologists and gastroenterologists are often unaware of the varying picture in the early stages.

Many authorities claim a high percentage of correct diagnoses in duodenal ulceration. This has led to the general belief that the roentgenologic diagnosis is made with comparative ease and should be possible in nearly all cases. Actually, the only cases diagnosed with ease are those which reveal marginal deformities or readily demonstrable ulcer niche defects. In the early stages of ulceration there are ordinarily no anatomic contour deformities, and the diagnosis is therefore more difficult. Both the gastro-enterologist and roentgenologist have long been aware of the fact that there are a large number of cases, presenting all of the clinical manifestations of duodenal ulceration, that are not confirmed by roentgen examination based solely upon the criterion of bulbar deformity. This group, however, presents mucosal roentgen changes which undoubtedly have been overlooked. The varying roentgen picture of the different phases of duodenal ulcer has led to some confusion regarding the diagnosis of this condition.

According to military regulations, those having active peptic ulcers are not acceptable for service. There has, however, been little effort on the part of the induction boards to prevent selectees with ulcers entering the armed services. The majority of cases could be eliminated by systematic fluoroscopic examination of the stomach. By far the greater number of peptic ulcers in men in the armed services have their onset prior to induction. Cases in which the ulcer syndrome developed after induction cannot be attributed to service disability, but rather to an aggravation by military life of a preexisting condition, formerly symptomless.

The incidence of duodenal ulceration among military combat personnel has been exceedingly high and constitutes a major medical problem. The British and Canadian experiences with combat soldiers have revealed an incidence of peptic ulcer in medical patients of over 50 per cent. On the basis of rejections by the selective service system, Kantor found that disqualifications for peptic ulcers were 5.5 per cent. In the Surgeon General's statistics for 1940, the digestive system ranked third as a cause of admission to sick report

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

and fifth as a cause of discharge for disability, while in 1941 it was shown to be responsible for 17.9 per cent of all hospital admissions.

In military practice the diagnosis of duodenal ulceration is generally made on definite objective evidence of a crater or marginal deformity. While this finding is the basis of all roentgen diagnoses of duodenal ulceration, there are other definite signs, the recognition of which is equally important. Roentgen demonstration of a marginal deformity or ulcer crater or niche defect is pathognomonic of duodenal ulceration. The ulcer niche, however, can be demonstrated only by the compression procedure, and its incidence varies considerably. In our experience it is seen in about one-third of all cases. Often the niche defect exists without marginal deformity and may not be demonstrable. In certain stages of the ulcer the contour of the duodenal bulb may not be affected. When one considers that the most frequent factor in the production of a bulbar deformity is the spastic phenomenon due to a contraction of muscle fibers surrounding the ulcer, it can readily be seen that in those cases which have not yet reached this stage no marginal deformity will be observed.

With the advance of roentgenologic knowledge regarding the early mucosal changes, it is now possible to detect most cases of duodenal ulcer with a high degree of accuracy. There has been too little consideration given to the roentgen findings in the various morphologic phases encountered in the development of duodenal ulceration. Although the pathologic stages have been amply recorded, there has been little interest in the protean phases of the roentgen picture in the early stages. It is true that these early roentgen signs are often evanescent and thus are easily overlooked, but failure to appreciate this changing picture may account for differences noted on repeated examinations.

There are four stages in the development of a duodenal ulcer: (1) edema and induration, (2) superficial erosion, (3) penetrating ulcer, (4) healing and cicatrization.

Roentgen recognition of early duodenal ulceration must be based upon the mucosal changes before the marginal deformities occur. The majority of ulcers are small and shallow. If a bulbar deformity is present, it is usually out of proportion to the true size of the ulcer. Scant attention has been given to the morphologic findings in ulceration involving the mucosa. The normal duodenal mucosal pattern shows a longitudinal arrangement of the rugae parallel with the long axis of the bulb. In duodenal ulceration there is a distinct change in this pattern, which may be seen in all stages of the development of the ulcer. The following changes may be observed: (1) veiling of the mucosal pattern; (2) edema and superficial induration in the ulcerated area, elevating the mucosa; (3) obliteration of the folds over the ulcer area; (4) thickening of the folds; (5) distortion of the longitudinal folds; (6) cross-bar folding of mucosa at right angles to the long axis of the duodenal bulb; (7) a criss-crossing, lace effect, or checker-board appearance of the mucosal pattern; (8) convergence of the folds toward the ulcer.

One of the earliest roentgen signs of duodenal ulcer is fragmentation of the barium-filled bulb. The production of the fragmentation sign is based upon two factors: localized edema and spasm. This sign is usually constant during the examination, but it may be transient. Although it is not so pathognomonic as marginal deformity or the niche, it is sufficient for a diagnosis, and since it occurs in the first stage of an ulcer, when marginal deformities are generally absent, it is most important that it be recognized. It is best demonstrated on fluoroscopic examination, utilizing manual compression. It is not ordinarily seen in roentgenograms made by the usual procedure, but may be demonstrated by the spot compression technic. It is often seen in an otherwise normal appearing duodenal bulb. On the

other hand, it is not always demonstrable.

In the early stages of duodenal ulcer one must also consider duodenal changes occurring in addition to the mucosal findings. These changes are physiological and produce important secondary roentgen phenomena. Often they give the first clue to the presence of an ulceration. The following secondary duodenal signs may be observed: (1) irritability of the duodenal bulb; (2) altered motility; (3) altered tone; (4) spasticity.

COMMENT

There is a fairly large proportion of symptomless young male adults who harbor a duodenal ulceration; while another group has intermittent slight dyspepsia, which is considered by the laity to be of no consequence. There is no way of knowing whether such persons have duodenal ulcers unless a thorough roentgen gastro-intestinal study is made. It is among these groups that some cases of duodenal ulceration are later found in the armed services. A third group, with known digestive disturbances, will also show duodenal ulcers after induction.

Many selectees claiming to have an ulcer have been declared negative on the basis of a gastro-intestinal roentgen study showing no anatomic deformity and accordingly have been accepted for service. After a period of three to five months many of these have been hospitalized for duodenal ulcer.

Still others, who have been under treatment for duodenal ulcer for a number of years, have been inducted into the armed services, only to be discharged for this disability. Some of these have had complications possibly brought on by their military activities.

Since the burden of proof of the presence of peptic ulcer rests with the inductee, a large number of men will invariably be accepted for military service with this disease. The military authorities have placed the responsibility for the diagnosis of peptic ulcer on the roentgenologist. Those draftees who present evidence of having this condition may be re-examined by the induction board or at military hospitals. Unfortunately, at the time of the re-examination some of them present no signs of an ulcer, on the basis of army x-ray regulations, and are inducted into the services. Many of these are later found to have a duodenal ulcer, sometimes with complications, such as perforation or hemorrhage.

It must be emphasized that, since the regulations require that an anatomic deformity must be demonstrable for a diagnosis of duodenal ulcer, many cases go undiagnosed. It is commonly known that duodenal ulceration in its early stages does not produce anatomic contour deformities of the duodenal bulb, but little consideration has been given to this phase of the problem. For this reason, and because of the failure to consider the earlier mucosal changes, a fairly large number of draftees are inducted into the services with duodenal ulcers. The strain of military service in such cases will often aggravate an already present peptic ulcer and provoke severe digestive symptoms.

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Primary Malignant Neoplasm of the Shoulder Joint, with Report of a Case[1]

HARRY A. OLIN, M.D.

PRIMARY MALIGNANT tumors of the joints are relatively rare, and the literature on the subject is limited. The chapter on "Tumors of Tendon Sheaths, Joints and Bursae" in Geschickter and Copeland's *Tumors of Bone* offers perhaps the best discussion (1). Codman (2) in his book, *The Shoulder*, covering an experience of many years, mentions no type of neoplasm arising in that joint.

Fibrosarcoma arising in the joint capsule appears to be the most common type of malignant tumor of the joints. Because of its slow growth in its early stages and a tendency to remain local over a period of months or years, this tumor is difficult of recognition and is probably often confused with benign fibroma, though the latter more commonly involves the tendon sheath. Since cartilage cells occur normally in the villous processes of the synovial membrane, loose bodies derived from synovial tags or fringes may become converted into cartilage, with the development, in some instances, of true chondromata. These may be single, but are usually multiple. Synovial sarcomas, though rare, may arise from the specialized connective-tissue cells, or fibrocytes, lining the synovial sheath (3). In the shoulder joint are various layers of connective tissue from the cells of which a malignant sarcoma may arise. The many reflections of the joint capsule and the extensive range of movement, with the possibility of repeated trauma, may be among the factors intimately concerned with the development of tumors.

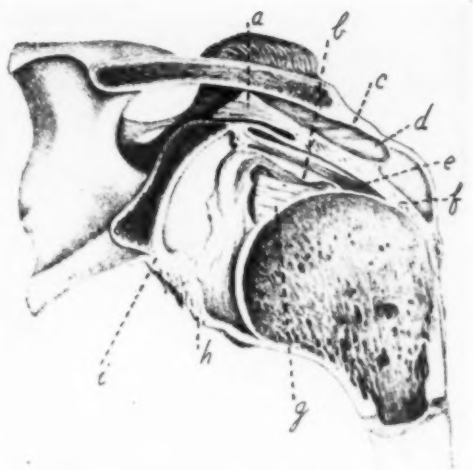

Fig. 1. Vertical section through shoulder joint, with head of humerus pulled away from glenoid, exposing fossa, capsular sac, biceps, tendon, etc. The sheath of the biceps tendon is continuous with the synovial lining of the capsule. *a*. Supraspinatus muscle. *b*. Glenohumeral ligament. *c*. Fibrous tissue between acromion and humerus. *d*. Subacromial bursa. *e*. Tendon of biceps. *f*. Capsular ligament. *g*. Tendon of subscapularis after it has penetrated fibrous capsule of joint. *h*. Capsular ligament. *i*. Glenoid ligament., *i.e.*, marginal fibrocartilage. From Morris' *Anatomy: Joints of Man*, 1879, Plate XX.

ANATOMY

Of all the joints, the shoulder probably possesses the widest range of motion. It may be considered as a shallow oval cup, deepened by circumferential fibrocartilage, in which the spherical head of the humerus rests, the entire articulation being enclosed in a loose sac—the capsule—intimately adherent to the margin of the glenoid cavity and possessing many reflections. The head is held in position not so much by ligaments as by muscles and the effect of atmospheric pressure. Reflections of the capsule are extensive and varied. It is intimately adherent, around the dorsal aspect of the scapula, to the prominent rough surface of the glenoid process, and even extends to the great scapular notch. Above, it is firmly attached to the root of the coracoid. On the inner side, it is attached to the ventral

[1] From Woodlawn Clinic and Hospital, Chicago, Ill. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

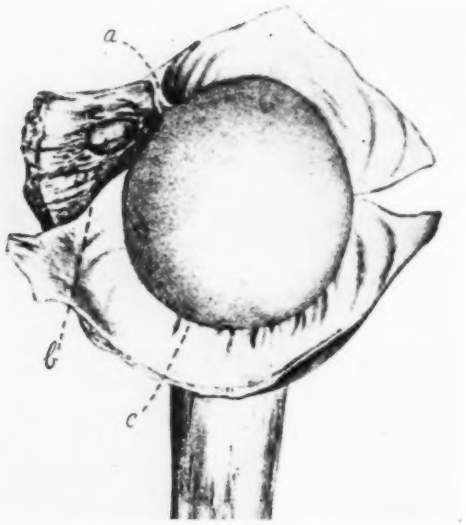

Fig. 2. Head of humerus with capsule of shoulder cut and reflected backward. The capsule forms a loose sac enveloping the head of the humerus. *a*. Glenohumeral ligament at its attachment. *b*. Sesamoid bone in subscapularis tendon. *c*. Reflection of some of the deeper fibers at lower and outer side. From Morris' *Anatomy: Joints of Man*, 1879, Plate XIX.

surface of the glenoid process and at a variable distance beyond, its fibers often extending several or more centimeters beyond the neck of the scapula and passing upward to the under surface of the coracoid. By these reflections and attachments, a rather loose pouch is formed. Below the glenoid fossa, the capsule blends with the origin of the long head of the triceps, arising from the axillary border of the scapula, and in its passage downward and outward its sheath is attached to the underside of the capsule. At the head, the upper one-half of the capsule is fixed to the anatomical neck and sends prolongations downward over the bicipital groove and biceps tendon. The lower half of the capsule descends upon the humerus further from the margin of the articular facet, but some fibers are reflected upward to be attached close to the articular margin and thus form, to a slighter degree, a fibrous investment for this part of the neck of the humerus (Fig. 1).

The tendons of the shoulder muscles which pass outward over the capsule from the ventral and dorsal surfaces of the scapula tend to strengthen the capsule, especially at their insertions, and are mainly responsible for holding the head of the humerus against the glenoid cavity. Sometimes a well formed sesamoid bone is present where the subscapularis is inserted into the lesser tuberosity.

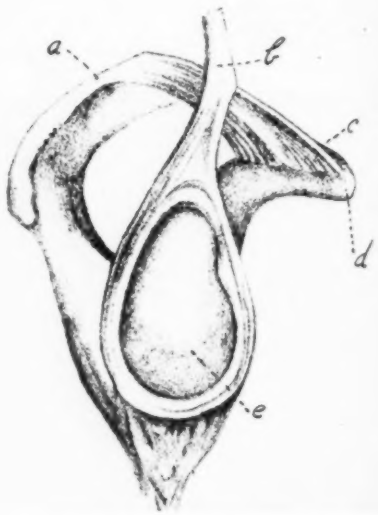

Fig. 3. Glenoid ligament thickened by fibers of the biceps tendon which bifurcates and passes around the rim, blending with joint cartilage. *a*. Acromion. *b*. Tendon of biceps cut and held up. *c*. Coraco-acromial ligament. *d*. Coracoid process. *e*. Glenoid fossa of scapula. From Morris' *Anatomy: Joints of Man*, 1879, Plate XIX.

The capsule presents a uniform thickness as a whole, but the inner portion below the border of the subscapularis is sometimes thicker. In the hip joint, greater thickness of certain portions of the capsule is essential for firmness and support; in the shoulder joint, this same degree of strength and steadiness is not required, since the upper limb is not weight-bearing but is almost solely designed for rapidity and extensive range of movement. Another band, sometimes called the coraco-humeral ligament by the older anatomists, which strengthens the capsule, extends from the greater tuberosity to the coracoid process, passes along the capsule in the line of the biceps tendon, with

which it becomes incorporated, and bridges over the bicipital groove. Reflections of the capsule in the form of bands covered by synovial membrane, called the glenohumeral process of the capsule, help to form a groove or sulcus for the biceps tendon and hold it in check to prevent any tendency to inward displacement (Fig. 2).

Besides the support which the capsule receives from the tendons, added strength is supplied by a strong fascia which passes over and beneath these reflected bands.

The glenoid ligament is a narrow band of fibrocartilage which is attached to the margin of the glenoid fossa and helps to deepen the cavity. At the upper part of the fossa the biceps tendon is prolonged into the glenoid ligament and forms an integral and important part of it. In fact, the tendon sends into the ligament fibers which wind around nearly the entire circumference of the socket (Fig. 3).

The articular cartilage covering the glenoid socket is thicker at the circumference than in the center and assists the glenoid ligament to deepen the cavity. The synovial membrane lines the fibrocartilaginous rim—the glenoid ligament—and is then reflected over the inner surface of the capsule to its attachment at the humerus. Sometimes the synovial cavity communicates with the subscapular bursa; less frequently with a bursa beneath the tendon of the infraspinatus muscle on the lateral aspect of the joint. Prolongations of the synovial membrane are frequently present, the most important of which are a pouch-like extension beneath the coracoid process and fringes along the margin of the glenoid cavity. These are the structures from which pathologists believe synovial sarcoma arises.

The blood supply of the shoulder is rich. It is derived chiefly from the subclavian artery through the suprascapular, and from the axillary artery through the anterior and posterior circumflex, the subscapular, dorsalis scapulae, and sometimes also through a branch direct to the joint. Free anastomosis occurs in the capsular ligament. In addition to the several vessels which run more or less directly to the joint, many twigs from the arteries to the muscles which pass off to it near the insertion of their tendons are connected with the capsule. From the ramifications on the outer side of the capsule, vessels penetrate its substance and in a well injected body can be seen from the inner surface ramifying beneath the synovial membrane. Arterial twigs enter the substance of both bones near the attachment of the capsule (4).

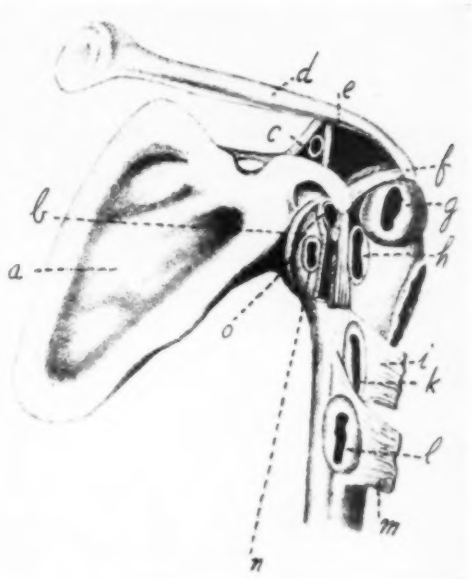

Fig. 4. Bursae in connection with shoulder joint *a*. Ventral surface of scapula. *b*. Cut tendon of subscapularis muscle. *c*. Bursa between coracoclavicular ligaments. *d*. Clavicle. *e*. Coracoid process. *f*. Tip of acromion. *g*. Subacromial bursa. *h*. Occasional bursa between biceps and coracobrachialis and capsule of joint. *i*. Teres major. *k*. Bursa beneath teres major. *l*. Bursa beneath latissimus dorsi. *m*. Latissimus dorsi. *n*. Bursa between subscapularis and capsule which often communicates with cavity of joint. *o*. Occasional bursa between tip of coracoid and capsule of shoulder.

BURSAE

There are several bursae in connection with the shoulder joint (Fig. 4).

(1) The subacromial or subdeltoid bursa—the largest and the most frequently brought to the surgeon's attention—is

situated between the tip of the acromion and the capsular ligament below. Morris states that in elderly people this bursa sometimes communicates through a large irregular opening with the synovial cavity of the joint.

(2) Bursa beneath the subscapularis, frequently communicating with the joint cavity.

(3) Bursa upon the capsule and between it and the subscapular tendon.

(4) A small bursa (sometimes absent) on the under surface of the tip of the coracoid process.

(5) An elongated bursa (sometimes absent) between the united coracobrachialis and biceps tendons and the capsular ligament.

(6) Three other bursae not directly placed over the capsule and yet in near relation are: (*a*) a bursa between the tendon of the teres major and humerus on one side and the upper part of the latissimus dorsi and humerus; (*b*) a bursa between the tendon of the latissimus dorsi and humerus; (*c*) a bursa between the tendon of the biceps and humerus. Codman is of the opinion that the subdeltoid, the subacromial, and subcoracoid are one and the same bursa, although they may be separated by films of tissue (2).

MUSCLES

In no other joint in the body do muscles play such an important part, not only strengthening the joint but preventing its displacement and at the same time taking a large share in controlling its movements. Four muscles may be said to be inserted into the capsule, while another passes beneath it, acting like a strap to prevent upward as well as lateral displacement and also as a sling to hold the bone against the humerus.

On the outer or extensor side are the supra- and infraspinatus and the teres minor—what some anatomists choose to call the conjoined tendon of the shoulder joint. On the flexor or anterior side, the subscapularis covers the shoulder and the upper and outer side are covered by the deltoid. The portion of capsule least supported by muscles is the lower or inner side. Here, too, the capsule is the thinnest and there is no projecting bony prominence like the coracoid or acromion to counteract the deficiency of muscular support in bearing pressure of the head of the humerus in states of abduction. Hence abduction, as in the hip, is the position of least safety and the one in which dislocation nearly always occurs

The muscles of the shoulder joint may be grouped according to their action into flexors, extensors, abductors, adductors, and rotators, with the premise, however, that some of them can produce different though not contrary actions in association with other muscles and some combine movement in two directions. Briefly the various groups are as follows:

Flexors
- Forward movement
  - Pectoralis major
  - Anterior fibers of deltoid acting alone
  - Coracobrachialis
  - Long and short tendons of biceps
  - When the arm is raised from the side it is abducted by the subscapularis also

Extensors
- Latissimus dorsi
- Backward movement
  - Posterior fibers of deltoid acting alone
  - Infraspinatus (when arm is raised)
- Swinging of the arm to and fro is made more free by forward, backward, and rotary movements of the scapula

Abductors
- Deltoid
- Supraspinatus
- (Combined use of these muscles raises the arm to a right angle with the trunk. Further elevation is produced by the action of the trapezius upon the scapula and is not a movement of the shoulder joint)

Adductors
- Forward
  - Pectoralis major
  - Coracobrachialis and biceps
- Backward
  - Latissimus dorsi
  - Teres major and minor
- Depressing raised arm may be accomplished either with flexion or extension
- The long head of the triceps adducts the arm after it has been abducted

Rotators
Subscapularis
Latissimus dorsi and teres major, to a lesser extent, when arm hangs by side
Teres minor and infraspinatus produce rotation outwards when arm hangs by side
Combined movements
A combination of the four common angular movements—flexion, extension, abduction, and adduction—in quick succession is called circumduction or rotation

PATHOLOGY

Not only are primary joint tumors rare, but a malignant bone tumor seldom invades an adjacent joint. Of 1,000 bone sarcomas seen in the Surgical Pathological Laboratory of Johns Hopkins Hospital and University (6), only 3 involved a neighboring joint. Fibrosarcoma is considered more frequent in the joint capsule than in other regions. The more usual tumors in this location are non-malignant growths derived from precartilaginous or preosseous tissue, such as osteochondroma, ganglion, and giant-cell tumor. Tumors occurring at this site not related to precartilaginous or preosseous tissue are angioma, lymphangioma, lipoma, fibroma, and fibrosarcoma. The two latter, considered rare, are more frequent in the neighborhood of a joint, tendon, or tendon sheath. Berger has reported four cases of synovial sarcoma in bursae.[2]

Razemon and Bizard (5) in 1931 were able to collect from the literature reports of 74 primary joint tumors of which 29 were malignant. Of the 45 benign lesions, 26 were xanthomatous or of the giant-cell variety and 17 were angiomas. One fibroma and one lipoma were recorded. In the malignant group, fibrospindle-cell sarcoma predominated, indicating an origin in the synovial membrane (a type of tumor called capsular sarcoma by Ewing). Other tumors in this group were one chondrosarcoma, 2 myxosarcomas, a liposarcoma, and other sarcomas of which the histologic type was not further specified. The majority of the malignant tumors recurred or produced metastases. Mention is made of a patient with a recurrent fibrosarcoma treated by amputation and alive twenty-seven months later. Twenty-five sarcomas involved the knee, the remainder the ankle. Osteochondromatosis with free bodies and cysts of the joint cartilage are not mentioned.

In a series of 30 cases listed by Geschickter and Copeland as encountered in the Surgical Pathological Laboratory at Johns Hopkins, there was a single fibrosarcoma. Their list is as follows (6):

Osteochondromas or chondromatosis	13
Cartilaginous cysts	2
Giant-cell tumors	3
Xanthomatous giant-cell tumors	5
Lipomas	4
Fibroma and fibrospindle-cell sarcoma (1 each)	2
Hemangioma	1
Total	30

This represents an incidence of malignancy in joint tumors of a little less than 3.5 per cent, whereas Razemon and Bizard's figure is about 40 per cent.

The difficulty experienced by pathologists in determining the exact origin of a joint tumor calls for some attention. From the gross appearance, fibroma and fibrosarcoma may be difficult to distinguish, and even histologically they may be confused. Whether a tumor is derived from tendon, tendon sheath, a connective-tissue structure in the joint, or the joint capsule, may offer a perplexing problem. Some tumors recorded as sarcomas are actually benign giant-cell tumors erroneously diagnosed (Geschickter and Lewis, 6). A variety of types of sarcoma have been reported (mixed, round-cell, spindle-cell, and endothelial sarcoma) in the bursa, similar to those involving the tendon, tendon sheath, and joint. Traumatic and inflammatory lesions are often difficult to distinguish from these tumors. Collins and Anspach report a case of fibrosarcoma of the plantar tissues which they believe originated in the joint capsule (7). Their

[2] Three of these, designated as endothelial synovial sarcoma, occurred in males 26, 30, and 38 years of age. All three recurred; two led to death, one and two years after onset. Berger believes that these tumors arise from the cells in serous bursae and discusses the details of their origin.

patient was observed over a period of two years before the correct diagnosis was made. Loss of density and cyst-like changes in the bone were the notable roentgen findings. The cyst-like changes were undoubtedly due to small foci of bone destruction similar to areas in the humeral head in the case to be recorded here. It is felt that, when these foci are present, tumor development is already well advanced.

CLINICAL PICTURE

Pain, excruciating in character and of increasing severity when the articular bone is involved, loss of function and of motion are the cardinal symptoms of malignant joint tumors. These may continue over a few weeks, months, or even years. With advanced disease, local swelling occurs, and there is marked tenderness. Cyst-like changes in the bone, due to multiple foci of bone destruction, may occur early. Pain even at this time is severe and exaggerated by motion. Metastases may occur early, although in Collins and Anspach's case secondary deposits in the groin and lungs were not discovered until two years after the appearance of the initial symptoms. Fibrosarcoma is considered by pathologists as radioresistant and commonly metastasizes to the lungs. While the tumor remains local, little or no variation from the normal is observed elsewhere in the body.

ROENTGEN FINDINGS

Early bone destruction is the notable and important roentgen finding in malignant tumors of the joints. Loss of bone density, obscure trabeculation or its complete absence, a hazy joint space, and thickening of the adjacent soft tissues may offer a clue to the diagnosis. Later, the articular bone surface presents small "cyst-like areas," the size of the head of a pin and larger, due to multiple foci of bone destruction. No evidence of bone repair is observed. In the shoulder the glenoid cavity presents the earliest destructive bone changes and the most extensive, followed by an inflammatory reaction, involvement of the joint cartilage and of the head of the humerus—the latter in the form of multiple small foci of cyst-like appearance.

DIFFERENTIAL DIAGNOSIS

For our purposes, the common diseases of the joints may be considered very briefly from the point of view of differential diagnosis. Such a group must include acute inflammation, tuberculosis, gonorrhea, and that perplexing and elusive group of chronic conditions which are designated by such terms as rheumatoid arthritis, osteo-arthritis, and arthritis deformans. Syphilis of the joint, too, may be added. An acute ankylosing arthritis may simulate the clinical picture of malignant joint tumor (8). Syphilis in the form of Charcot's joint, tuberculosis, and infectious arthritis are too well known to merit further description. They may simulate joint tumor especially in the early destructive stage. Next to roentgen investigation, joint aspiration probably offers the best diagnostic avenue of approach; the presence of malignant tumor cells confirms the clinical impression. If these procedures fail, an exploratory incision followed by biopsy will corroborate the tentative clinical diagnosis.

REPORT OF CASE

Mrs. M. A., aged 43 years, was seen June 7, 1942, having been referred by her family physician, who had been treating her for several weeks for a painful shoulder. Her story was as follows:

Pain in the right shoulder began about eight weeks earlier and for the past three or four weeks had been very severe, involving the entire shoulder, radiating down the arm to the elbow. Motion was limited and there was tenderness throughout the shoulder, with some fullness in the anterior and posterior areas. The patient stated that she had felt well up to the onset of the pain. Before this, she had worked hard nursing her son, who was very ill. For the past four weeks, the pain had been extremely severe, continuous, and gnawing in character. She had required sedatives for several nights prior to coming for x-ray examination.

The physical examination, except for the shoulder, was essentially negative. Blood pressure was 180/36. The sedimentation rate showed a 24 mm. drop in one hour, as compared to the normal 1 to 9.

Roentgen examination (stereoscopic, anteropos-

terior), June 11, 1942, revealed an area of bone destruction at the neck of the scapula, invading the glenoid fossa and extending into the base of the coracoid process (Fig. 5). The joint capsule showed invasion and there was surface involvement of the head of the humerus in the form of small punctate areas, the size of the head of a pin and larger. Bone destruction was seen in the spine of the scapula extending within several centimeters of the vertebral border. Because of the extreme pain, roentgenograms could not be obtained in other planes. There was no evidence of disease in the lungs or lumbar spine.

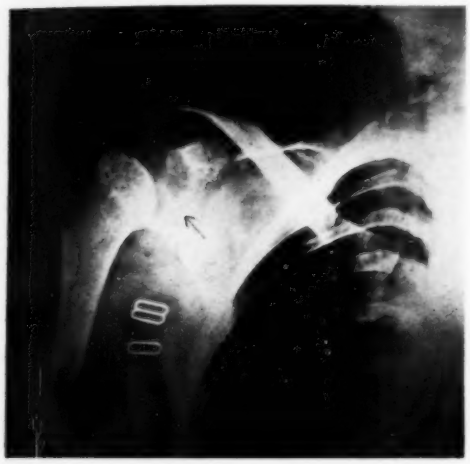

Fig. 5. Fibrosarcoma of the shoulder joint. Note extensive destruction in glenoid cavity and adjacent bone. In the head of the humerus are numerous cyst-like areas which are foci of necrotic bone.

Diagnosis: Destructive lesion of shoulder joint. Metastasis, tuberculosis, primary tumor to be considered.

The blood picture (June 7) was as follows: red cells 4,760,000; hemoglobin 85 per cent; white cells 29,800, polymorphonuclears 71, eosinophils 6, lymphocytes 17. On June 13, the white count had risen to 34,300.

The patient was referred to Dr. Edward L. Compere, who on June 13 performed a shoulder girdle amputation followed by several blood transfusions.

The specimen studied consisted of numerous pieces of soft tissue, ranging in color from cream to yellowish cream, and two pieces of bone. One of the latter was saddle-shaped, measuring 2.0 × 2.5 × 1.0 cm. Its external surface was rough and appeared to be devoid of periosteum; its concave surface presented a moth-eaten surface. Most of bone could be easily crushed. The smaller piece of bone measured 1 cm. in diameter and was of the same consistency as the large piece (Fig. 6).

Sections (Fig. 7) showed a peculiar arrangement of tumor cells in a fibrous stroma, which on low magnification, had a fenestrated appearance. The tumor cells varied considerably in size and the nuclei somewhat resembled fibroblasts. Cytoplasmic limits were often indefinite and in many places there were giant cells. Mitotic figures were numerous. Spicules of dead bone were found in the mass, but there was no evidence of new bone formation. The spaces between the tumor cells resembled fat spaces. A small strip of periosteum showed tumor tissue on both sides. The main tumor growth, however, appeared to be on the inside of the periosteum. An occasional large giant cell had the appearance of a megalokaryocyte, which is further evidence that the tumor probably originated in the marrow cavity.

Fig. 6. Specimen removed at operation (shoulder-girdle amputation). Courtesy Dr. Edward L. Compere.

Diagnosis: Atypical fibrosarcoma, probably from the endosteum (Dr. Strauser).

The microscopic sections were submitted to three other pathologists, two of whom have had a large experience with bone tumors. All concurred in the diagnosis and referred to the presence of necrotic bone and inflammatory tissue. A medullary fibrosarcoma of bone was the designation of one; a pleomorphic fibrosarcoma of bone of another. All mentioned the presence of many spindle cells, some giant cells, and numerous mitotic figures in some areas.

The patient was readmitted Sept. 11, 1942, with metastases in the left femur, knee, left side of the neck, and lungs. She died several weeks later. (Patient in service of Dr. E. L. Compere.)

COMMENT

The noteworthy features in this case are the acuteness of the symptoms and the rapidity of growth of a destructive tumor of a joint which apparently was well

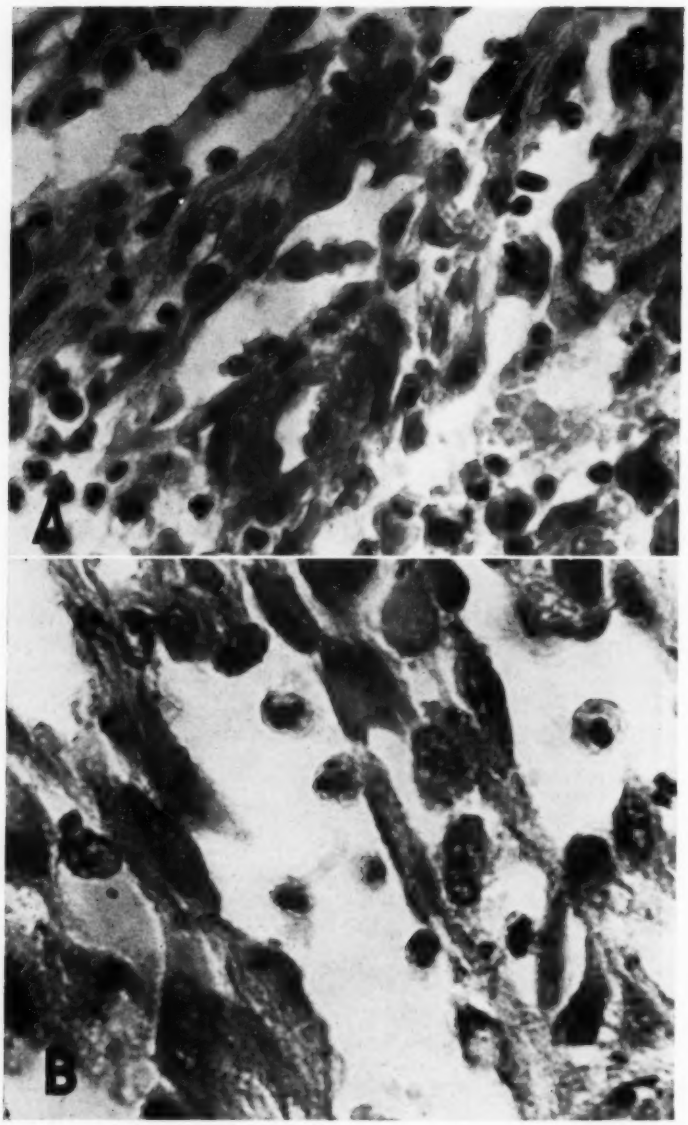

Fig. 7. Low-power and high-power photomicrographs of fibrosarcoma of shoulder joint. Bundles of tumor cells with large spindle-shaped oval and round nuclei are separated by wide blood spaces. Several multinucleated giant cells are present and there is infiltration of polymorphonuclear leukocytes. The nuclei in some of the multinucleated cells are rich in chromatin.

advanced when the patient was first seen by her family physician. A high degree of malignancy is established by the concordance of opinion of all the pathologists consulted. Since the roentgen examination revealed marked surface destruction of the glenoid cavity, haziness of the joint surfaces, and small cyst-like areas of bone destruction in the head of the humerus (the tumor evidently beginning to cross the joint), the possibility of a metastatic growth arises. Certainly tumor cells were present beyond the site of origin. Since the destruction was greatest in the glenoid cavity, it is fair to assume that the tumor may have originated there, either in the synovial membrane or in the endosteum, as indicated by one of the pathologists.

Pathologists have frequently remarked that this type of tumor is radioresistant. Collins and Anspach's patient responded remarkably well to irradiation, even though the symptoms at the time of treatment were of two years' duration. It is purely conjectural what effect roentgen therapy would have had in this case.

CONCLUSIONS

Primary joint tumors are rare and malignant tumors are rarer still. The anatomy and physiology of the shoulder joint are presented here in some detail with the idea that their consideration may be of some aid in the interpretation of the origin of a tumor, when the pathological and other data are carefully analyzed. The structures which enter into the formation of a joint are the articular surfaces of bone covered by hyaline cartilage, the epiphysis, in some cases the epiphyseal cartilage and metaphysis and the synovial membrane. Added to these are the many bursae in the shoulder joint, some of which connect with the synovial cavity. The exact origin of a sarcoma may be difficult for a pathologist to determine, but the source of tissue not related to precartilaginous or preosseous tissue varies widely, from the bursa to the synovial membrane. Inflammatory conditions induced by trauma, to which the shoulder joint is especially subject, may be a contributing etiologic factor.

A case is presented of fibrosarcoma of the shoulder joint, with symptoms of eight weeks' duration. Early bone destruction of the glenoid cavity, a hazy joint space, and multiple small foci of bone destruction in the head of the humerus were the important roentgen findings. A shoulder girdle amputation was performed. Metastases in the lungs, femur, and neck were present three months later. Death occurred about fourteen weeks after operation.

NOTE: I am greatly indebted to Dr. Gouwens for the privilege of using the clinical material and to Dr. Edward L. Compere, who kindly furnished a photograph of the specimen and other aid. I also wish to thank Dr. Strauser for several microscopic slides and his interpretation, and Dr. A. C. Strunk and Melvin H. Battenberg for their patience in securing satisfactory photomicrographs for reproduction.

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Nomographic Aids in Calculating Radium Dosage for Plane and Point Sources[1]

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CALCULATIONS of radium dosage were considerably simplified by the contributions of Paterson and Parker (1, 2). For radium sources, filtered by 0.5 mm. Pt or its equivalent, distributed on square or circular areas, the number of milligram hours required to deliver 1,000 gamma roentgens could be determined from a group of graphs. The same data can be put in the form of an alignment chart or nomogram. The advantages of a nomogram are that it is compact and that no interpolation is required in order to obtain intermediate values. With very little practice, nomograms can be used with facility and speed.

The nomogram (Fig. 1) presented for this purpose consists of three vertical scales. On the left-hand scale is found the area in square centimeters. On the scale in the center is found the treatment distance in centimeters. The right-hand scale has divisions on both sides. The divisions on the right side of this scale are labeled at the top "Mg. Hrs."; the divisions on the left side of this scale are labeled at the top "%."

To find the number of milligram hours required to deliver 1,000 gamma roentgens, one finds the area on the left-hand scale and the treatment distance on the scale in the center. Then, a straight edge, *e.g.*, a ruler, preferably transparent, is placed across the chart through the points selected on these two scales. The straight edge intersects the right-hand scale at a certain point. The figures on the right side of this scale give the same result as the Paterson and Parker area graphs but expressed per square centimeter. When this figure is multiplied by the area, the number of milligram hours required to deliver 1,000 gamma roentgens is obtained. For filtration equivalents other than 0.5 mm. Pt, the Paterson and Parker correction figures are used (Table I). The figures on the left-hand side of the third scale are discussed below.

TABLE I: FILTRATION CORRECTION FACTORS FOR RADIATING AREAS, AFTER PATERSON AND PARKER

Thickness, mm. Pt	0.3	0.5	0.8	1.0	1.5	2.0
Multiply mg. hr. by	95%	100%	105%	110%	120%	135%

Gold: As platinum.
Lead and Silver: As half their thickness in platinum.
Monel, Brass, Steel: As one-quarter their thickness in platinum.

For square areas, Paterson and Parker gave definite distribution rules specifying the amount of radium to be placed on lines added within the square separated by twice the treatment distance. Unfortunately, the exact linear strengths and lengths that these rules require are rarely available. It usually turns out that the figure of practical importance is the percentage of the total amount of radium that must be placed on the lines added within the square. The figures on the left-hand side of the third scale, labeled at the top "%," are these percentages, *i.e.*, they give the percentage of the total amount of radium that must be placed within the periphery of a square. These figures apply when more than one line is added. If only one line is added, the percentage is always 11 per cent.

These percentage figures may also be used for rectangular areas up to the point at which one side is twice as long as the other. Corrections for more elongated rectangles are given in Table II. These figures for rectangles apply when more than one line is added. If only one line is added, and one side of the rectangle is at least

[1] From the Department of Radiotherapy, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in September 1943.

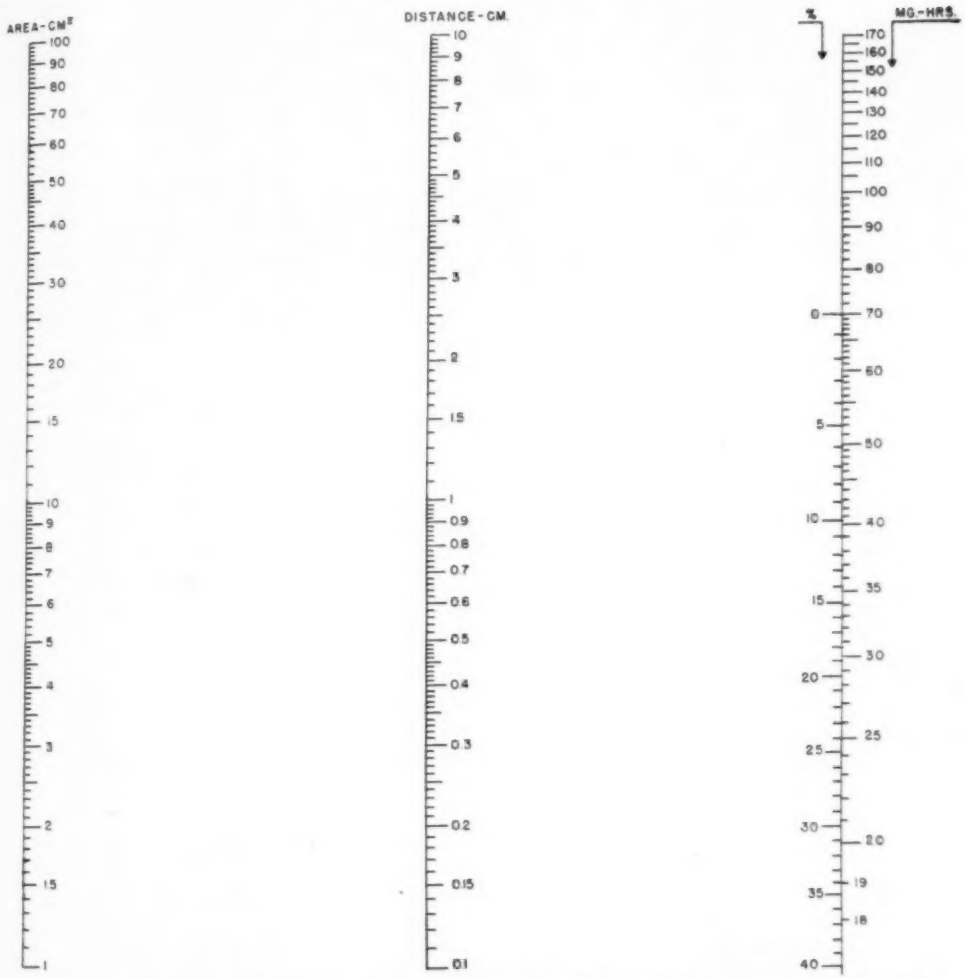

Fig. 1. Nomogram to calculate dosage for radium sources distributed on square and circular areas. For explanation, see text.

twice the other, the percentage is 15 per cent.

TABLE II: ELONGATION CORRECTION FACTORS FOR PERCENTAGES OF RADIUM TO BE CENTRALLY PLACED
(Sides of rectangle are a and b)

Elongation	$b = 2a$	$b = 3a$	$b = 4a$
Subtract	5%	9%	12%

The percentage figure in the nomogram gives the amount of radium which must be placed on the central lines as the percentage of the *total* amount of radium. It is sometimes more useful to express the amount of central radium required as a percentage of the radium on the *periphery* (abbreviated "% of peripheral radium") rather than as a percentage of the total radium (which includes both the peripheral and central radium). These two percentages are related by a simple formula:

$$\%\text{ of peripheral radium} = \frac{\%\text{ of total radium}}{1 - \frac{\%\text{ of total radium}}{100}}$$

The figures for milligram hours may also be used for areas in the shape of equilateral triangles, with the following rules of distribution:

(1) When the ratio of the side of the triangle to the treatment distance is no greater than 4, no additional central radium is required.

(2) When this ratio is greater than 4 but not greater than 8, 10 per cent of the total amount of radium should be centrally placed.

An example for a rectangular area will illustrate how the nomogram and correction factors are used.

the radium capsules. The thickness of this material must then be measured, and it may turn out to be not exactly 0.5 cm. but, *e.g.*, 0.6 cm. With the nomogram, the calculation is equally easy with either of these two thicknesses. (This is not true of the Parker graphs.) Let us assume that it turns out to be 0.6 cm.

We now have determined the exact area (8.8 sq. cm.) and treatment distance (0.6 cm.) to be used. By placing a straight edge on the nomogram through 8.8 on the left-hand scale and 0.6 on the center scale (Fig. 2), we find from the right-hand scale that 28.1 mg. hr. are required per square

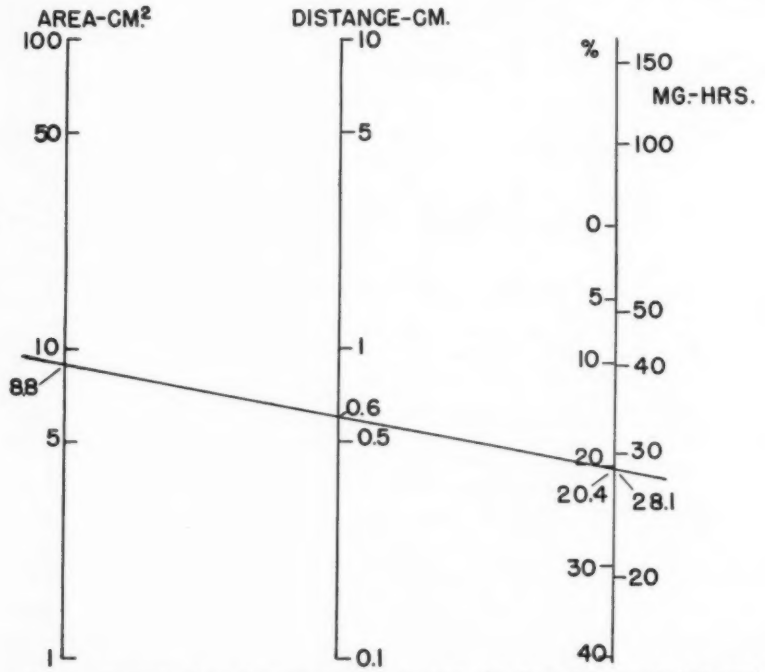

Fig. 2. Example of use of nomogram. A straight edge through 8.8 on the left-hand scale and 0.6 on the center scale intersects the right-hand scale at 28.1 mg. hr. and 20.4 per cent.

EXAMPLE: Assume a limited supply of 10- and 15-mg. radium capsules with filtration equivalent to 1.0 mm. Pt, 2.2 cm. over-all length, and 1.8 cm. active length. It has been decided to treat an area on the skin approximately 4 by 2 cm. by a plaque at about 0.5 cm. from the skin and the dose desired is 3,000 gamma roentgens.

With capsules of these dimensions, an area exactly 4 by 2 cm. cannot be obtained without overlapping the ends. This is undesirable because portions of the capsules are then at different distances from the skin. To avoid this, the area treated is made 4.4 by 2 cm. A slab of wax or dental compound of suitable dimensions is selected to carry centimeter to deliver 1,000 gamma roentgens (if filtration were 0.5 mm. Pt and the area square). Since the area is a 2:1 rectangle, 5 per cent must be added to the number of milligram hours (Table II). Since filtration is 1.0 mm. Pt, an additional 10 per cent must be added (Table I).

115% of 28.1 = 32.4 mg. hr. per sq. cm.
32.4 × 8.8 = 285 mg. hr. to deliver 1,000 gamma roentgens.
285 × 3 = 855 mg. hr. to deliver 3,000 gamma roentgens.

Also, from the scale labeled "%," we find that 20.4 per cent of the total amount of radium should

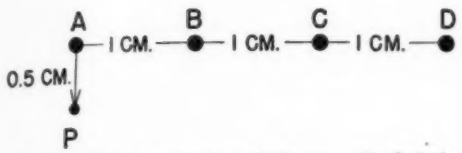

Fig. 3. Point sources in a single row. To find the dose at P, the distance from each point source to P must be calculated and then substituted in the inverse square formula.

be placed within the periphery (if the area were square). Since the area is a 2:1 rectangle, 5 per cent must be subtracted from this percentage (Table II):

$20.4\% - 5\% = 15.4\%$ of the total amount of radium is to be placed within the periphery.

$$\% \text{ of peripheral radium to be centrally placed} = \frac{15.4}{1 - \frac{15.4}{100}} = \frac{15.4}{1 - 0.154} = \frac{15.4}{0.846} = 18.4$$

or, with sufficient accuracy, 18%.

We may place 15-mg. capsules in the periphery, two for each long side and one for each short side. This gives 90 mg. in the periphery. We desire 18 per cent of 90, or 16 mg. along a center line. The best we can do with the radium supply available is to place a single 15-mg. capsule in the center. Total number of milligrams in the plaque will then be 105 and the time required will be 855 divided by 105, or 8 hours and 9 minutes.

The distribution of the linear radium sources on the plaque finally used deviates considerably from a perfect Paterson and Parker distribution. In order to determine how great the difference is at any point, it is necessary to calculate the dose at that point from each linear source separately. Data have been given in a previous publication (3) which simplify this type of calculation.

Calculation of dosage "in air" from point sources of radium element or emanation, though theoretically simple, is frequently quite tedious. The reasons for this are that point sources are usually multiple and the formulae which must be used in the calculation are arithmetically rather cumbersome. It becomes necessary to calculate the distance from each source to the point at which the dose is to be calculated and then substitute this distance in the inverse-square formula. If the filtration is

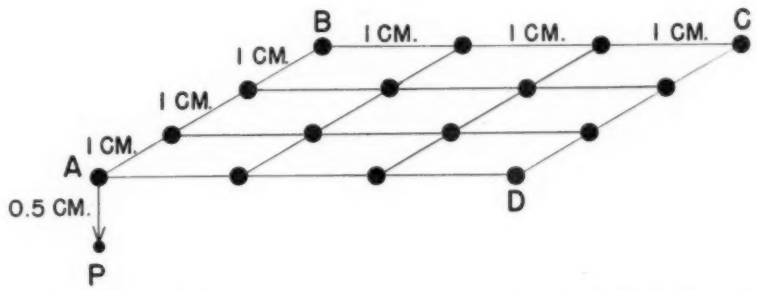

Fig. 4. Point sources in several rows. To find the dose at P, the distance from each point source to P must be calculated and then substituted in the inverse square formula.

0.5 mm. Pt, and the figure 8.4 is taken as the number of gamma roentgens from a 1-mg. point source of radium element in 1 hour at 1 cm., the inverse-square law may be written:

$$\text{Dose in gamma roentgens per milligram hour} = \frac{8.4}{\text{distance}^2}$$

The various distances are calculated from the Pythagorean formula

$$\text{Distance}^2 = X^2 + Y^2 \qquad (1)$$

if all the points concerned (including the point at which the dose is to be calculated) lie in the same plane; or from the formula

$$\text{Distance}^2 = X^2 + Y^2 + Z^2 \qquad (2)$$

if all the points do not lie in the same plane. It is easiest to explain what X, Y, and Z represent by two short examples.

EXAMPLE 1 (Fig. 3): Suppose that four point sources were used in a line, separated from each other by 1 cm., and that we desire to calculate the

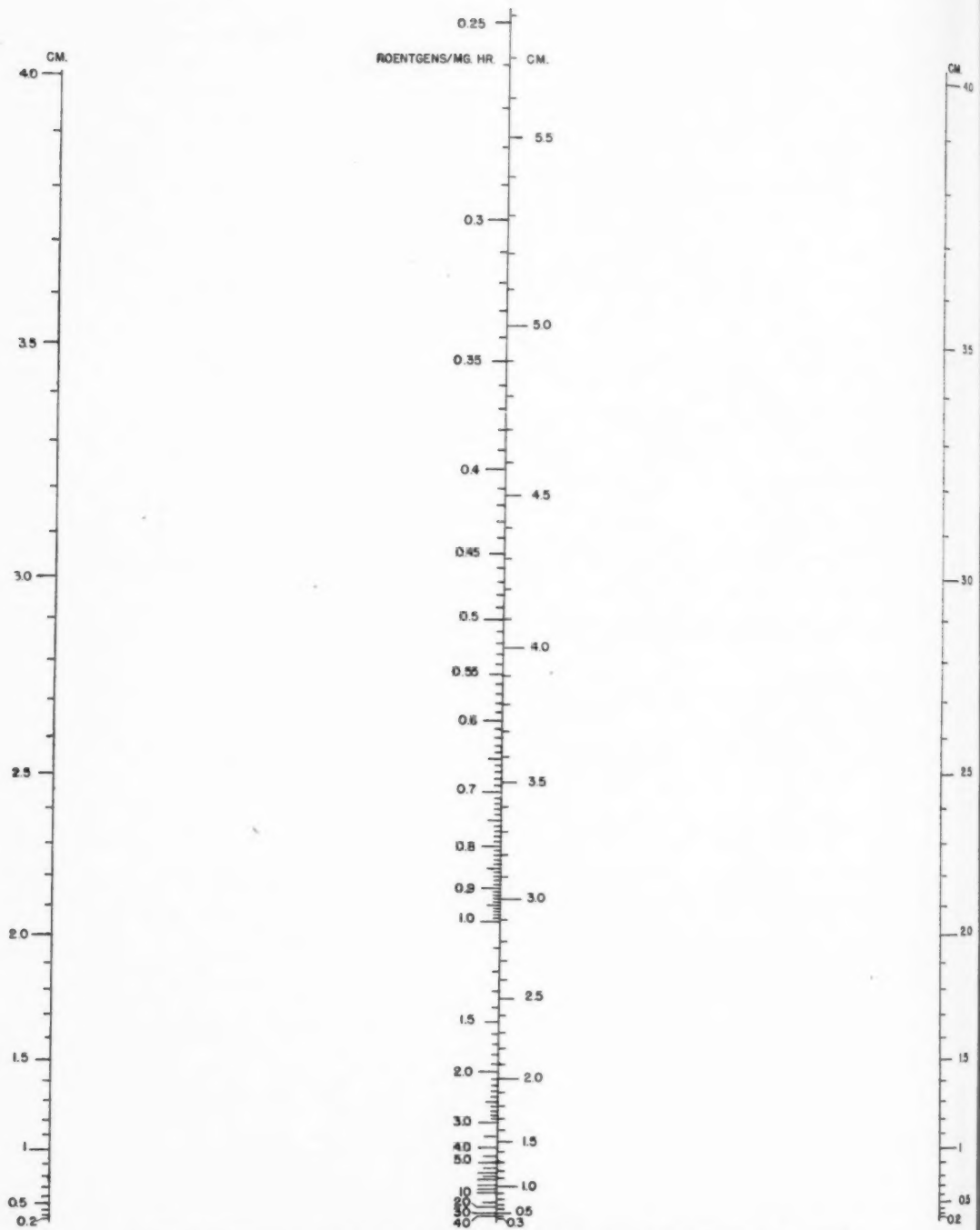

Fig. 5. Nomogram to calculate dosage from point sources. For explanation, see text.

dose per milligram hour at P from the point source at D, filtration 0.5 mm. Pt.

The distance from D to P or DP is calculated from the known distance AD (= 3 × 1 cm. = 3 cm.) and the known distance AF (= 0.5 cm.).

The distances AD and AP are represented by X and Y in the general formula (1).

$$\text{Distance}^2 = X^2 + Y^2$$
$$DP^2 = AD^2 + AP^2$$
$$DP^2 = 3^2 + 0.5^2 = 9.25$$
$$DP = 3.2 \text{ cm.}$$

$$\text{Dose per milligram hour} = \frac{8.4}{DP^2} = \frac{8.4}{9.25} = 0.91$$

gamma roentgen.

In the same way, it is easily found that the dose per milligram hour from a point source at A is 33.6; from B, 6.7; from C, 1.98 gamma roentgens. The dose at point P for 4 mg. hr. would then be the sum of the four figures, or 43.2 gamma roentgens if the radium is equally distributed at the points A, B, C, and D.

EXAMPLE 2 (Fig. 4): Suppose that sixteen point sources were used on four lines, separated from each other by 1 cm., the four point sources on each line being also placed 1 cm. from each other. We desire to calculate the dose per milligram hour at P from the point source at C, filtration 0.5 mm. Pt.

The distance from C to P or CP is calculated from the known distances BC (= 3 × 1 cm. = 3 cm.), AB (= 3 × 1 cm. = 3 cm.), and AP (= 0.5 cm.). These distances are represented by X, Y, and Z in the general formula (2).

$$\text{Distance}^2 = X^2 + Y^2 + Z^2$$
$$CP^2 = BC^2 + AB^2 + AP^2$$
$$CP = 4.27$$

$$\text{Dose per milligram hour} = \frac{8.4}{CP^2} = \frac{8.4}{18.25} = 0.46$$

gamma roentgen.

To shorten the time required for these calculations, a nomogram (Fig. 5) and an auxiliary scale (Fig. 6) are presented.

The nomogram consists of three vertical scales. The scale in the center and the auxiliary scale are used independently of the two outer scales of the nomogram when the distance is known without further calculation, as for a single point source. Then one simply finds the distance on the right side of one of these scales and reads on the left side the dose per milligram hour in gamma roentgens. The auxiliary scale is necessary to cover the range of short distances with accuracy. It would seem at

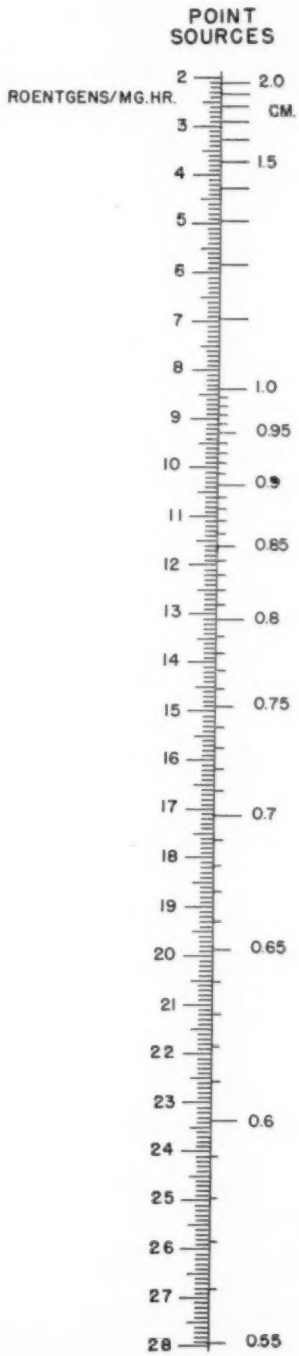

Fig. 6. Auxiliary scale to calculate dosage from point sources.

TABLE III: FILTRATION CORRECTION FACTORS FOR POINT SOURCES ACCORDING TO LAURENCE

Thickness, mm. Pt	0.3	0.5	0.8	1.0	1.5	2.0
Multiply roentgens by	103%	100%	97%	94%	87%	82%

first sight that the largest distance included in these two scales is 5.8 cm. and that one could not obtain the dose if the distance, *e.g.*, was 6 cm. This difficulty is easily overcome by using multiples of 10. For example, the dose at 6 cm. is simply one-hundredth of the dose at 0.6 cm. and the dose at 0.6 cm. can be found on the auxiliary scale without difficulty.

When the distance is not known directly but must be calculated from two known distances X and Y, as in Example 1 above, then the full nomogram is used. One finds X on the left-hand scale of the nomogram and Y on the right-hand scale and connects these two points by a straight edge. This straight edge intersects the central scale at a point which gives the dose (and incidentally the distance).

When the distance must be calculated from three known distances, X, Y, and Z, as in Example 2, the nomogram must be used twice. First, one connects X and Y, as in the previous case, but reads off from the central scale, not the dose, but the distance. Then, this distance is found on the left-hand outer scale and joined to Z on the right-hand outer scale by a straight edge. The point thus found on the central scale gives the dose.

For filtrations other than those equivalent to 0.5 mm. Pt, correction factors must be applied. These factors, calculated from data of Laurence (4, 5), are given in Table III. These are not the same factors used for linear or plane sources.

When the radiating source is surrounded by tissue, corrections for tissue absorption must be used. Average correction figures were calculated by Laurence (4, 5) and are given in Table IV.

The above data are based on the assumption that the radiating source is actually a point. This is clearly not true of any source in actual practice. The dose as calculated is therefore a little high. In the average case, however, this error does not exceed 5 per cent.

TABLE IV: CORRECTION FACTORS FOR TISSUE ABSORPTION ACCORDING TO LAURENCE

Thickness of tissue, cm.	1	2	5	7	9	12	14	16	18	20
Multiply roentgens by	98%	95%	92%	89%	85%	80%	76%	73%	70%	67%

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Roentgen Detection in an Army General Hospital of Chronic Diseases Not Excluded by Induction Boards[1]

MAJOR LUCIEN M. PASCUCCI, M.C., A.U.S.

ROENTGEN EXAMINATION for excluding from the armed services selectees with pulmonary tuberculosis has proved invaluable. Two years of experience in an army general hospital has confirmed this fact and has in addition convinced the writer that x-rays have not been employed to greatest advantage in the initial examination of other systems of the body. The purpose of this paper is to present material in support of this conviction.

The O'Reilly General Hospital is now a 2,200-bed institution serving the entire Seventh Service Command; patients are also received from all theaters of operation for treatment and disposition. During the first year of operation, the patients consisted largely of recently inducted enlisted men who were having difficulty in adjustment to army routine because of mental and physical disturbances which had existed prior to induction. Many were adjusted satisfactorily in civilian life; but the abrupt change, the mental and physical strain, and the rugged discipline resulted in an exacerbation or intensification of symptoms. With the onset of hostilities following the attack on Pearl Harbor, battle casualties were admitted. Though casualty admissions now greatly exceed those from the zone of the interior and communications, the soldier-patient with disease antedating induction continues an important problem of disposal.

MATERIAL

This study covers approximately 9,000 military admissions from Nov. 1, 1941, to June 1, 1943. It is estimated that about 80 per cent were recent inductees. The diseases of roentgen interest encountered were bronchiectasis, urinary calculi, post-traumatic brain atrophy, herniated disk, spondylolisthesis, colitis, and peptic ulcer. The gastro-intestinal disorders have been found to be second in importance to the neuropsychiatric diseases in this hospital

BRONCHIECTASIS

The diagnosis of bronchiectasis is difficult from the ordinary plain film; it can be made with certainty only upon the demonstration of dilated bronchi by means of an opaque solution. Occasionally one may find a "honeycomb" appearance typical of advanced disease, but this is not the rule. A negative chest film and a history of a persistent productive cough warrant a study with iodized oil. Only by this means can early lesions be detected. There were 30 patients with bronchiectasis in the series under consideration; in 24, or 80 per cent, the disease antedated entrance into the army (Table I). These men had an average length of service of six months. In 22, or 91 per cent of the 24, the lesions were demonstrable by lipiodol study.

URINARY CALCULI

Urinary calculi, if they are opaque to the roentgen ray, are easily visible on the routine flat film of the abdomen. Renal and bladder stones are often silent; if not, the symptoms may be mild and cause no undue disturbance. It is not too difficult to conceive of the physical activity peculiar to the army aggravating or actually initiating colic. A flat film of the abdomen is indicated where a history of abdominal pain or renal or ureteral colic is elicited. There were 37 patients in the series with calculi; this diagnosis was primary in 29. In 24, or 83 per cent of the 29, symptoms were present before induction. Two-thirds of these men, with an average length of service of eight

[1] From the Radiological Service of the O'Reilly General Hospital, Springfield, Missouri. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

TABLE I: BRONCHIECTASIS AND URINARY CALCULI. COMPARATIVE STATISTICS FOR PATIENTS WITH LINE OF DUTY STATUS YES AND THOSE WITH SYMPTOMS PRIOR TO INDUCTION

	Bronchiectasis	Urinary Calculi
Number	30	29
Existed prior to induction or enlistment	24 (80%)	24 (83%)
X-ray positive	22 (91%)	...
Length of service (av.)	6 months (1–29 months)	8 months (1–31 months)
Discharged	24 (100%)	16 (66%)
Line of duty status yes	6 (20%)	5 (17%)
X-ray positive	6 (100%)	...
Length of service (av.)	5 years (4 months–24 years)	2 years (7 months–4 years)

months, were given a medical discharge (Table I).

POST-TRAUMATIC HEAD SYNDROME

The severity of an injury incurred several or more years prior to military service is not appreciated without careful and pointed questioning, which has not been possible during induction examination. Therefore, the necessity arises for the use of key questions. This is particularly true for injuries to the head and spinal column, in which sequelae are apt to be frequent and serious, yet not apparent during the brief period of investigation. These cerebral and spinal column disorders comprised a large group in our study. The majority of the men were so handicapped that a medical discharge resulted. Such roentgen diagnostic methods as encephalography and myelography were not employed in many in whom the symptoms preceded induction and in whom the diagnosis was obvious clinically. These procedures, however, were utilized more freely in those whose injury was incurred in line of duty.

Of 78 patients with a post-traumatic head syndrome, 41, or 53 per cent, stated that its onset was in civilian life (Table II). Of the 15 in whom encephalographic studies were made, 12 (80 per cent) showed evidence of atrophy. On the other hand, this change was found in only one-third of those examined in line of duty. Thus 23 per cent of the total number of patients with post-traumatic head syndrome gave positive findings. The true figure is no doubt higher, since, as stated above, encephalograms were not made in all cases.

NUCLEUS PULPOSUS

The syndrome resulting from a rupture of the annulus fibrosus is characteristic enough so that a clinical diagnosis is possible in over 90 per cent of all cases. Roentgen methods are as accurate, but it must be cautioned that in a small percentage opaque studies will fail to disclose a herniation. An opaque medium is invaluable where pressure on the nerve is absent, when symptoms are vague, and when the question of a neoplasm arises. In our early examinations we employed air or lipiodol. All our recent lumbar injections have been done with pantopaque, which was easily and completely withdrawn immediately following the termination of the examination. No unpleasant after effects were noted. Of 114 men in whom the diagnosis was made, 79, or 70 per cent, had symptoms antedating induction (Table II). Of these, 76, or 96 per cent, were discharged. The average length of service was seven months.

SPONDYLOLISTHESIS

Spondylolisthesis is easily diagnosed on routine films of the lumbar spine. Of the 18 men in whom this diagnosis was made, 16, or 89 per cent, had an average length of service of seven months (Table II). All were discharged. The remaining 2 had five and six years of service and were not discharged, though it was recognized that the defect existed prior to enlistment.

PEPTIC ULCER

Chronic disease of the digestive tract is the second largest cause of permanent invalidism at this hospital. Schindler (1) stated in March of 1942 that chronic ulcer would certainly be one of the most common diseases in the army. British

TABLE II: POST-TRAUMATIC HEAD SYNDROME, HERNIATED NUCLEUS PULPOSUS, SPONDYLOLISTHESIS. COMPARATIVE STATISTICS FOR PATIENTS WITH LINE OF DUTY STATUS YES AND THOSE WITH SYMPTOMS PRIOR TO INDUCTION

	Post-Traumatic Head Syndrome	Nucleus Pulposus	Spondylolisthesis
Number	78	114	18
Existed prior to induction or enlistment	41 (53%)	79 (70%)	16 (89%)
X-ray examination	15	4	....
X-ray positive	12 (80%)	2	....
Length of service (av.)	9 months (1–24 months)	7 months (1–30 months)	7 months (1–15 months)
Discharged	40 (98%)	76 (96%)	16 (89%)
Line of duty yes	37 (47%)	35 (30%)	....
X-ray examination	18	16	....
X-ray positive	6 (33%)	14 (88%)	....
Length of service (av.)	2.5 years (4 months–24 years)	2.5 years (2 months–18 years)	....
Discharged	27 (73%)	....	....

authors are agreed that dyspepsia constitutes for them the major medical problem of this war. Thus it is evident that the immediate recognition of such cases and their proper disposition will avert much confusion, dissatisfaction, and injustice when the war is over. The draft and induction boards can, with the aid of specialists and facilities in the increased number of army hospitals, now eliminate not only those with active and quiescent ulcers but also the recruit with a psychoneurotic tendency in whom ulcers are prone to develop.

There were 542 admissions of enlisted men to the gastro-intestinal ward; 215, or 40 per cent, had duodenal ulcers (Table III). This figure of 40 per cent, which does not include duodenal ulcers in officers or gastric ulcers, is not so high as that given by Tidy (2), who showed that of 2,500 consecutive military patients with dyspepsia admitted to various hospitals in England, 51.9 per cent had peptic ulcers. If dyspepsia had been included in the series reported here, it is reasonable to assume that a closer approximation would have been obtained. There were only 12 benign gastric ulcers; curiously enough none was seen in the officer group. Our ratio of duodenal to gastric ulcers is 18 to 1, which corresponds exactly to that given by Flood (3). Only 77 per cent of our patients had symptoms prior to induction, which is lower than the 93 per cent of Flood (3) and 90 per cent estimated by Hurst (4) and Tidy (2) independently. Our recent inductees had an average length

TABLE III: DUODENAL AND GASTRIC ULCER AND COLITIS. COMPARATIVE STATISTICS FOR PATIENTS WITH LINE OF DUTY STATUS YES AND THOSE WITH SYMPTOMS PRIOR TO INDUCTION

	Duodenal Ulcers	Gastric Ulcers	Colitis
Number	215	12	31
X-ray positive	181 (84%)*	12 (100%)	9 (40%)†
Existed prior to induction or enlistment	165 (77%)	5 (42%)	23 (74%)
Crater	41 (30%)	.....	.....
Deformity	98 (70%)	.....	.....
Average length of service	7.5 months (2 days–32 months)	9 months (2–32 months)	10 months (1–23 months)
Discharged	165 (100%)	5 (100%)	23 (100%)
Line of Duty Yes	50 (23%)	7 (58%)	8 (26%)
Crater	9 (21%)	.....	.....
Deformity	33 (79%)	.....	.....
Average length of service	8 years (5 months–28 years)	13 years (11 months–21 years)	1 year (8 months–2 years)
Discharged	45 (90%)	2 (29%)	.....

* The remainder had positive findings at transfer station and were healed or gave typical story without demonstrable crater or deformity.

† That is, 40 per cent of those in whom the disease existed prior to induction.

of service of 7.5 months and all, without exception, were discharged. The high incidence (70 per cent) of deformity (Table III) is noteworthy in that it indicates the presence of long-standing chronic disease in the majority of those recently enlisted. More craters might have been demonstrable had a compression spot device been available.

COLITIS

Colitis is a disabling disease. The chronic ulcerative type is permanently disabling. Of 31 cases, 23, or 74 per cent, were classified as having existed prior to induction; the average length of service was ten months (Table III). Nine, or 40 per cent, of the patients showed roentgen evidence of ulceration. Three were so ill they could not be examined. All of the recently inducted patients were discharged but one, who died.

COMMENT

A summation of statistics for the disease entities described shows that 71 per cent existed prior to induction; that the average length of service in patients with preinduction disease was eight months; that of these, 94 per cent were given a certificate of disability discharge. Thus, it is obvious that more than two-thirds of the enlisted patients with these chronic ailments, which are amenable to x-ray diagnosis, had the disease in civilian life. Over 90 per cent were subsequently discharged back to civilian status. The average length of service of eight months is not considered long enough for the development of a trained soldier. Moreover, it is hardly likely that during this period efficient or satisfactory duty was possible.

Why have these men escaped detection by the examining boards? There are several reasons. Some men failed to mention their symptoms because they were not questioned about them specifically. Others failed to mention them because they were in a state of remission or because they were not considered serious. This was especially true of many with ulcers, who interpreted their difficulty simply as indigestion. Many enumerated their symptoms, but these were not believed to be significant by the examiners and therefore not investigated. Perhaps the greatest handicap has been the lack of time available to the medical boards for the taking of adequate histories. This is important, since the type of specialized examination to be performed is most dependent upon the history. Any effort to improve the accuracy of selections will be valueless unless this fact is recognized.

The experience acquired since November 1940 should be applied, since new man power is continually necessary for replacement and expansion. The establishment of a larger peacetime army and the possibility of compulsory conscription in the future will require more careful sorting of recruits. This can be materially aided by the use of an objective method such as roentgen examination. Many well equipped army hospitals have been built where roentgen procedures can be satisfactorily accomplished if civilian facilities are not available. The formation of specially trained and experienced medical teams may also be indicated. More credence and emphasis will have to be placed on the history of cough, digestive complaints, abdominal and back pain, and injury to the head and spinal column with subsequent pain on activity. Certainly the time expended in special procedures will not approximate the ineffective eight months spent in the service and the expense of hospital care and observation required before discharge.

SUMMARY

1. Experience in an army general hospital has shown that draft and induction boards have failed to detect many chronic diseases which with a more careful screening process could have been excluded.

2. These diseases are bronchiectasis, urinary calculi, post-traumatic brain atrophy, herniated intervertebral disk,

spondylolisthesis, duodenal and gastric ulcer, and colitis.

3. The taking of an adequate and careful history is essential. More attention must be given to such symptoms as cough, injuries to the head and spinal column with subsequent pain on activity, and indigestion.

4. The wide application of specialized x-ray procedures, such as bronchography, intravenous urography, encephalography, myelography, gastro-intestinal series, and barium enema studies may be justified only when performed by trained personnel, since any accompanying risk is practically negligible.

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Value of the Delayed Examination in Pyelography[1]

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WHEN THE URINARY tract is investigated by retrograde pyelography, additional roentgenograms made subsequent to the usual routine can be of great value. In the presence of a retentive hydronephrotic kidney, for example, roentgenograms made as late as twenty-four hours after the pyelogram have suggested the nature of the lesion.

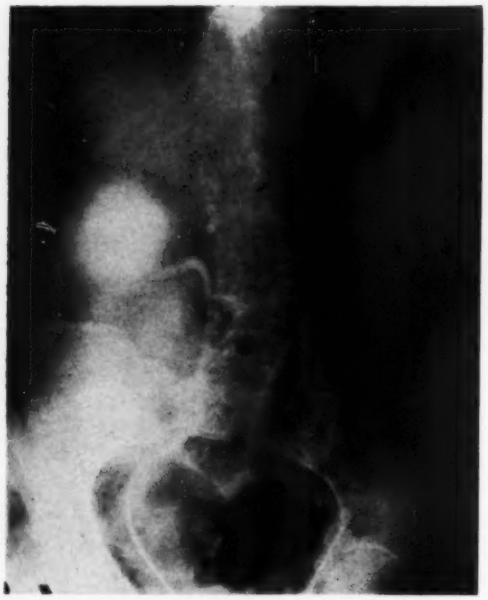

Fig. 1. Roentgenogram made immediately after the injection of 20 c.c. of skiodan. The large kidney mass can be seen readily. The opaque medium fills the right ureter and a portion of the upper pole of the kidney. The dye in the kidney is ill defined and was thought to be loculated.

M. L., white female, age 81, was admitted with a history of right lower quadrant pain radiating to the back. The first episode had occurred three weeks before admission and was accompanied by mild abdominal distention. The symptoms subsided in a few days, recurring on the day of admission.

The possibility of an intestinal obstruction was considered, especially when physical examination revealed a large right-sided abdominal mass. Roentgen study of the abdomen disclosed a large, soft-tissue mass in the right renal area. A barium enema study showed the colon to be normal. An intravenous urogram showed normal morphology of the left urinary tract, but no clearance of diodrast on the right. A retrograde study on the right revealed a circular dye shadow with poorly defined margins in the kidney region (Fig. 1). A roentgenogram made twenty-four hours later showed that the dye previously injected had diffused throughout the soft-tissue mass, indicating a large hydronephrotic sac (Fig. 2).

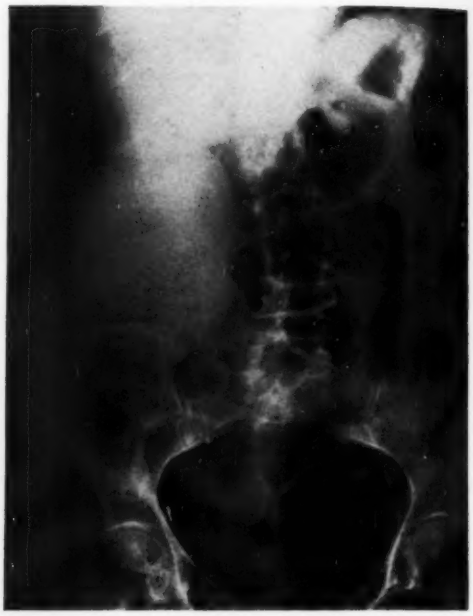

Fig. 2. Same case as Fig. 1: Examination twenty-four hours later. The dye is now distributed throughout the kidney, having diffused into the retained fluid.

Urine: Specific gravity (unconcentrated specimen), 1.019; albumin, faint trace; white blood cells, 25–30, per high power field.

Blood: Hemoglobin, 90 per cent; red cells, 4,000,000; white cells, 7,500.

Because of the patient's age and the rapid subsidence of symptoms, operation was not advised.

In this case the diagnosis was suggested by the earlier films, but the extent of the

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lesion and its relation to the large soft-tissue mass were more exactly determined at twenty-four hours, when the dye previously injected had diffused throughout the dilated pelvis.

This procedure should be of value in those instances of a cavity containing fluid not amenable to drainage, in which ultimate but not immediate diffusion of the contrast medium can be attained. If the fluid-containing cavity is thoroughly drained at the time of catheterization, complete refilling with an opaque medium will result at once.

To determine the necessity for delayed films the routine films should be studied immediately after processing. The time interval for the delayed examination will likewise be determined from the appearance of the conventional films.

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Aortic Arch and Cardiac Mensuration[1]

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CARDIAC MEASUREMENT was the height of medical fashion and considered sacrosanct a quarter of a century ago. *The Heart and the Aorta; Studies in Clinical Radiology*, by H. Vaquez and E. Bordet is still a valuable reference book, copied by many subsequent authors. The more recent work of Hugo Roesler, Geza Nemet, and others, in cardiodynamics, with the brilliant anatomical fact finding by Robb and Steinberg's angiocardiography, places greater importance upon the individual cardiac segments and diminishes the value of cardiac mensuration. This still holds its place, however, as a permanent record for future estimation of progress.

Numerous workers have employed many methods of mensuration, each fitting in with the particular needs or whims of the individual investigator. It is not my desire to criticize or compare these. It is rather my purpose to set down the simplest procedure found feasible in my own experience with cardiac mensuration and to point out a practical variation from the standard technic in the measurement of the aortic arch.

A routine postero-anterior teleroentgenogram is made at 6 ft. (2 meters) distance with the patient standing in vertical position facing the film and in full inspiration, at 150 ma. and kv. variation corresponding to the postero-anterior thickness of the chest. After dark-room processing, the measurement procedure is as follows:

A preliminary survey is made of the chest to make certain that no conditions which would interfere with measurement exist, *e.g.*, spinal curvature, mediastinal deviation, mediastinal or hilar disease, pleural effusion, etc. A mid-line is drawn by dropping a plumb line through the posterior spinous processes of the midcervical vertebrae. This can be checked against the equidistance of the sternal ends of the clavicles. Next a horizontal line is drawn at the level of the cardiophrenic angle. Along this is measured the chest transverse diameter (Chest T.D.) from the inner rib borders on each side.

The greatest distance of the heart is then measured to the right of the mid-line (M.R.) and similarly to the left (M.L.). The sum of these two gives the transverse diameter, T.D., of the heart. The ratio of this to the chest transverse diameter is figured out in fraction form (2:1 ratio) or decimal percentage method (50 per cent).

The aortic arch mensuration is obtained by measuring the greatest distance from the mid-line to the left, which roughly approximates a 10:1 ratio to the chest transverse diameter. This variant in measurement we have found most satisfactory, because it eliminates the need to hunt for the right aortic arch margin so often hidden behind the sternum. The routine aortic arch transverse diameter is the sum of that part of the ascending portion of the arch which extends from the mid-line to the right border plus the part of the descending portion of the arch which extends from the mid-line to the left border.

W. W. Fray utilized the left anterior oblique position to measure the transverse diameter. Sosman emphasized the importance of the caliber of the aortic arch measured in the right anterior oblique. Roesler measured the aortic arch in the right anterior oblique after introduction of barium paste into the esophagus to delineate the adjacent right border of the arch. All these procedures necessitate either extra exposures to x-ray and a contrast medium, or both. This is obviated in the procedure here described, and the process is thereby simplified.

In a typical average small chest the x-ray examination would be reported as

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follows: Lungs clear. Heart normal in contour and size. Cardiac measurements as follows:

M.R. 4.2 cm.
M.L. 8.1 cm.
Heart T.D. 12.3 cm.
Chest T.D. 25.0 cm.
Cardiothoracic ratio 12.3/25 = 49 per cent

The aortic arch passes 2.5 cm. to left of the mid-line. The aortic thoracic ratio is 10 per cent (or 1 to 10).

SUMMARY

A simple routine of cardiac mensuration is set forth for future record and comparison purposes. This is not complete but is ample for routine work.

The aortic arch measurement is standardized by taking the distance from the mid-line to the left.

This procedure has been found practical in over twenty years' experience.

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Training of X-Ray Technicians at the School for Medical Department Enlisted Technicians[1]

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THREE YEARS AGO, at the beginning of the army expansion program, it became apparent that a large number of trained technicians would be needed for service in the Medical Department of the United States Army. Although the proposed army of that time was relatively small compared with the present army, it was discovered shortly that the available technicians in the United States could not begin to fulfill the requirements of the armed forces. Furthermore, it was learned that the civilian schools and hospitals in which technicians could be trained were grossly inadequate to carry on such a tremendous task without seriously interfering with their normal essential functions. In view of these facts, the problem of training came to rest directly on the army.

At that time, the facilities within the army for training technicians were limited to a single school at the Army Medical Center, Washington, D. C. Obviously, this one school could not supply the thousands of technicians required for the various specialties, *i.e.*, medicine, surgery, radiology, laboratory technic, dentistry, and pharmacy. To provide a means of training additional enlisted medical personnel, plans were developed for the construction of additional training centers in different parts of the country. Of these new schools, the School for Medical Department Enlisted Technicians at the Fitzsimons General Hospital, Denver, Col., was one of the first to be opened.

The X-Ray Section of the Fitzsimons School was first placed in operation on April 1, 1941. Since then, this school alone has supplied many hundreds of x-ray technicians to the armed forces.

Through necessity, the United States Army has thus had the opportunity not only to train hundreds of x-ray technicians but also to observe the results of such training. It is on the basis of such observation and experience during the past two and a half years that I wish to make the following remarks concerning the training of x-ray technicians. It is my sincere belief that we at Fitzsimons have developed a training program which has proved to be superior in many respects to the usual methods employed.

Simultaneously with the development of this school have come changes in the curriculum and in the methods of teaching. It is interesting to note that the changes which have been made have resulted largely from suggestions made by the students while enrolled here, through communications received from students who have graduated, and from radiologists in various army hospitals. Thus, the training program has been evolved from the experience of many persons with various responsibilities in the field of radiology.

The course for x-ray technicians at the present time extends over a period of three months, during which time the student receives 504 hours of technical instruction. This teaching occupies seven hours a day, six days a week. In addition, to the technical training, each student also receives an hour and a half a day of military training, which includes dismounted drill, calisthenics, parades, etc.

During the first month of the technical training an effort is made to familiarize the student thoroughly with the electro-

[1] Such schools are conducted by the Army and Navy General Hospital, Army School of Roentgenology, Wm. Beaumont General Hospital, Billings General Hospital, Brooke General Hospital, O'Reilly General Hospital, Fitzsimons General Hospital, Lawson General Hospital, Letterman General Hospital.

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physical principles concerned with the production of x-rays, the nature and physical properties of the x-ray beam, and the manner in which x-rays are made use of in roentgenography. Because of the multiplicity of subjects covered in the first month, the scope of this training is best set forth in outline form as follows:

ELEMENTARY PHYSICS
- Atomic and electronic theory of matter
  - Construction of matter
  - Construction of molecules and atoms
- Magnetism
  - Types of magnets
  - Atomic and molecular theories of magnetism
  - Magnetic lines of force
  - Laws of magnetic force
  - Magnetic induction
- Electromagnetism
  - Relationship between magnetism and electricity
- Electricity
  - Electron theory of electricity
  - Electrical potential
  - Motions of electrons
  - Methods of causing electrons to flow
  - Conductors and insulators
  - Types of electricity
  - Types of electrical circuits
  - Electrical terminology
  - Ohm's law
  - Power law
  - Electrical measuring devices
  - Electrical controlling devices
  - Theory of electromagnetic induction, Lenz's law, induced e.m.f.
  - Motors
  - Generators
  - Transformers, conventional, auto-transformer

RADIOLOGIC PHYSICS
- Production of x-rays
  - Conditions necessary for the production of x-rays
  - Relation of kv.p. and ma. to the production of x-rays
- Rectification, mechanical, valve tube
- Wiring diagrams of x-ray circuits
  - Self-rectified
  - Mechanically rectified
  - Single-valve tube, half wave rectified
  - Four-valve tube, full wave rectified
  - Three-phase apparatus
  - Condenser discharge apparatus
- Calibration of x-ray machines
- Trouble shooting and service of x-ray apparatus
- X-ray tubes
  - Gas tubes
  - Hot cathode tubes
  - Variable-focus tubes
- X-ray tubes—*cont.*
  - Line-focus tubes
  - Double-focus tubes
  - Rotating anode tubes
  - Shockproof and rayproof tubes
- Radiant energy
  - Theories of radiant energy
  - Electromagnetic spectrum
  - Nature of the x-ray beam
  - Characteristics and physical properties of the x-ray beam
  - Methods of utilizing the x-ray beam
  - Methods of identifying the x-ray beam

RADIOGRAPHY
- Prime factors: ma., kv.p., distance, and time
- Film factors: detail, density, contrast, and distortion
- The x-ray film
- Processing of the x-ray film

The above subject material is presented to the students both in didactic lectures and in laboratory work, there being three hours a day of each type of instruction. The laboratory classes are so arranged that small groups of students either have demonstrated to them, or demonstrate to themselves, the material covered in the lectures. The remaining hour of each day is spent in small conference groups or in supervised study, during which time an instructor is present to aid the student with any problems which he may encounter.

The second month of instruction initiates the student into the technic of radiography. The 168 hours of instruction are divided in the following manner: 72 hours are allotted to radiography, 24 hours to film criticism, 24 hours to osteology, and 48 hours to laboratory work.

Approximately one hour of the three hours devoted to radiography is occupied in instructing the student in one or more of the standard radiographic positions of small parts of the body. This instruction includes both a lecture and a practical demonstration by the instructor in charge of the group. This instruction is supplemented by the use of lantern slides, which depict the various radiographic positions by means of models and demonstrate the radiograph obtained by such positioning. During the remaining two hours of this period the students occupy themselves by

taking radiographs of each other in the positions taught them that day.[2]

During the hour set aside for film criticism, the class is divided into small groups, and the films which the students have taken on the previous day are criticized by a medical officer. These films are analyzed from the standpoint of detail, density, contrast, distortion, and the position of the part on the film. If for any reason the film is found to be unsatisfactory or if the student has failed to identify the film properly, etc., he is called upon to suggest the modifications in his technic which would produce a satisfactory radiograph. The film is then rejected and the student must repeat the radiography of that particular part until a satisfactory result is obtained. This period of film criticism is also a valuable means of reviewing the radiographic anatomy discussed in the regular anatomy lectures.

The anatomy lectures of the second month occupy one hour daily and are confined to osteology. Each bony structure of the body is discussed from the standpoint of its gross anatomy, and special emphasis is placed on the radiographic significance of its various parts. A skeleton is used by the instructor during his lecture and is available to the student for reference at all other times. These lectures are also supplemented by lantern slides and radiographs of the various parts of the body, and a sincere effort is made to correlate the anatomy with the radiography. It is felt that such constant repetition of subject material, not only in this field, but in all subjects taught, enables the student to grasp and to retain the important knowledge much more efficiently than an attempt to present one particular subject at a single sitting. Thus, at all times, the men are held responsible for any material covered up to that particular point in the course.

The two hours a day allotted to the laboratory are intended to acquaint the student with the various radiographic accessories and to familiarize him with the many aspects of radiography separate from the actual taking of radiographs. This includes instruction in the following:

- Darkroom procedure
  - Construction of darkroom
  - Chemistry of processing
  - Handling of x-ray film
- Administration
  - Care of supplies, records, reports, etc.
  - Organization of x-ray departments in military hospitals
- Intensifying screens
  - Purpose
  - Construction
  - Care
- Secondary radiation
  - Scattered
  - Characteristics
  - Corpuscular
  - Stray
- Cones, cylinders, diaphragms
  - Purpose
  - Construction
  - Use
- Potter-Bucky diaphragm and stationary grids
  - Purpose
  - Construction
  - Use
- Precautions in x-ray work
  - Dangers of electrical shock
  - Dangers of x-ray exposure
- Calibration of x-ray apparatus
  - Practical work
- United States Army field x-ray unit
  - Construction
  - Wiring diagrams
  - Operation
  - Assembling and disassembling unit
- X-ray tubes
  - Tube rating charts
- Prime factors of radiography
  - Detail
  - Density
  - Distortion
  - Contrast
  - Methods of compensating for changes in the prime factors

[2] When the practice of using students as subjects for radiography was first begun, the question arose as to the harmful effects which the students might experience from the many x-ray exposures. In order to avoid local damage to any skin areas, the students are carefully instructed in the skin tolerance dose, and an accurate record is kept of the amount of x-ray exposure to each part of the body. As a check against any harmful systemic effect, each student receives a complete blood count before he is exposed to any radiation and another similar blood count near the end of the course, or at any other time that it is deemed necessary. To date, hundreds of blood counts have been made on the students and instructors, and an analysis of these blood studies has revealed nothing to indicate that the students have received or are receiving a quantity of radiation which is deleterious to their health.

Models of the different radiographic accessories discussed are available for the students to examine, and many schematic models have been constructed by various members of the department to demonstrate or to emphasize certain points.

In addition to the work within the radiographic buildings, the men are started on field work and field problems such as they might encounter in actual combat. This includes instruction in assembling, operating, and disassembling the pieces of field equipment that have been specifically developed for this type of work, such as the field x-ray unit, the motor generator, the portable darkroom equipment, etc.

The work of the third month is in many respects similar to that of the second month except that it is more advanced. The 168 hours of instruction are divided in the following manner: 72 hours are allotted to radiography, 24 hours to film criticism, 36 hours to radiographic anatomy and physiology, and 36 hours to laboratory.

The three hours a day devoted to radiography constitute a continuation of the radiographic work of the second month. During this month the students are instructed in the radiography of the heavier parts of the body, as the skull, the spine, the chest, etc. The work of the second-month students is all performed on the field unit, which has an output of 30 ma., whereas the radiography of the third month is, for the most part, accomplished on stationary units with an output of 100 or 200 ma. In all, each student is required to have a minimum of 50 radiographs completed and passed during his second and third months of work. Instruction is given, however, in additional positions which the student may work on in his spare time.

The film criticisms of the third month are conducted precisely as those of the second month.

The anatomy lectures of the third month embrace a discussion, not only of the anatomy of the various systems of the body, but of their physiology as well. These lectures are presented in such a way that the radiographic importance of the organ or organs being studied is emphasized. Thus, lectures on the biliary system are approached from the standpoint of a cholecystogram, those on the gastro-intestinal tract from the standpoint of a gastro-intestinal series and a barium enema, etc. These lectures, like those of the second month, are all supplemented by lantern slides, models of the organs being studied, etc.

The laboratory work of this month includes instruction in the following subjects: fluoroscopy, photofluorography, stereoscopy, laminagraphy, kymography, and foreign body localization. During this period, the use of the field equipment is enlarged upon and the student is given the opportunity to take a number of radiographs under field conditions. On frequent occasions this work is carried on in conjunction with the work of the medical and surgical sections of the school, and thus the student is provided with the opportunity of taking radiographs of simulated battle casualties—men whose extremities may be supported in splints or who may have various other types of dressings applied to the part to be examined. Frequent trips to the x-ray clinic of the Fitzsimons General Hospital familiarize the student with the operation of a large x-ray clinic and serve as a review for much of the material covered in the didactic lectures.

This last month includes a brief introduction to the field of x-ray therapy, although the scope of this instruction is limited, since most of the students will have no contact with x-ray therapy except perhaps that administered by the field unit. Lectures are also given on the ethics of x-ray technicians, and the students are constantly admonished as to the dangers of interpreting x-ray films when serving in the capacity of technicians.

Technical manual 8-240, "Roentgenographic Technicians," is used as the official, basic textbook. Other text and teaching

aids employed in carrying on the above instruction have, for the most part, been developed by persons working in the x-ray section. The student is, however, encouraged to indulge in collateral reading, and a library, containing many of the standard texts on physics and radiography, is available for this purpose at any time. All phases of the instruction are punctuated by frequent examinations, both written and practical, and those students who do not appear to be grasping the material as well as would be hoped are given additional tutoring.

At the present time, the greatest shortcoming of the entire course, as I see it, is the failure to be able to provide more practical hospital experience. I do not feel, however, that this constitutes such a serious objection, since, upon graduating, these men are assigned to hospital clinics in which there is generally a wealth of clinical experience. Furthermore, plans have already been developed extending the period of instruction to four months, in which case the students will be given the opportunity for actual work in the Fitzsimons Hospital x-ray clinic along with the regular technicians.

The reports which I have received from radiologists in army hospitals who have had the opportunity of observing the quality of the x-ray technicians trained under such a system as outlined have been most gratifying. I have been particularly impressed with the manner in which our graduates have been able to adapt themselves to the routine of the many varied radiographic departments to which they have been assigned, and the way in which they have been able to adjust themselves to the idiosyncrasies and wishes of the radiologists in charge of these various departments. Not only have these men proved to be superior technicians, but in many instances they have been of value in servicing and maintaining the equipment in their clinics.

My experience in training x-ray technicians in accord with the method outlined has convinced me of the desirability of instituting some similar method of education for civilian student technicians. In this respect, I would like to suggest to the profession the possibility of endorsing or even establishing similar schools in civilian practice. It is my opinion that a well rounded course in the fundamentals of radiography should precede the hospital work of a student x-ray technician just as a course in medical school precedes the hospital work of a hospital intern. Such a practice would accomplish several very desirable results:

1. The training program for x-ray technicians would be more or less standardized throughout the country.
2. This training would be of benefit to physicians beginning their study in radiology.
3. The expensive errors occasionally committed by the neophyte technician would be less likely to occur.
4. The radiologist would be provided with a technician who would be of practical value from the very beginning of his or her hospital work.

CASE REPORTS

Congenital Absence of a Lung Diagnosed before Death[1]

E. R. DEWEESE, M.D., and JOHN C. HOWARD, Jr., M.D.
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Congenital absence of a lung is looked upon as a rare occurrence. To substantiate this claim, a review of the literature reveals only 38 authenticated cases since Haberlein (2) reported the first example in 1787. The rarity of this condition is further borne out by the fact that only 3 of the recorded cases were diagnosed before death and in a number of instances aplasia of the lung was not suspected but was found at routine autopsy following death from trauma. Hurwitz and Stephens (5), reporting a case in 1937, tabulated details of the 34 cases recorded up to that time, with references to the original reports. The accompanying table brings their review to date. The feeling persists, however, that aplasia of the lung occurs much more frequently than is generally suspected and the possibility of such an occurrence should be considered in differential diagnosis of diseases of the chest, particularly in what appears to be a persistent atelectasis.

CASES OF CONGENITAL ABSENCE OF LUNG RECORDED FROM 1937 TO DATE

(Cases up to 1937 (1–34) tabulated by Hurwitz and Stephens)

Author	Sex and Age	Absent Lung	Autopsy Findings
35. Hurwitz, S., and Stephens, H. B. (Am. J. M. Sc. **193:** 81, 1737)	Female 7 weeks	Left	The rudiment of tissue that represented the left lung was attached to the end of a short narrow bronchus and weighed 2.5 gm. A vein from it entered the right vena azygos. Fetal lung tissue hypertrophied; one-lobed right lung
36. Elward, J. F. (Radiology **27:** 667, 1936)	Male 43 years	Left	Right lung hypertrophied. A rudimentary left lung 3 × 1½ inches, fibrotic and adherent to the posterior chest wall. Bronchi incarcerated in a mass of adhesions. Marked diminution of left pulmonary artery
37. Van Loon, E. L., and Diamond, Sydney (Am. J. Dis. Child. **62:** 584, 1941)	Female 3½ years	Right	Child alive at time of report
38. Madigan, D. G. (Tubercle **22:** 144, 1941)	Female 23 years	Left	Right lung extending across mid-line with compensatory hypertrophy.
39–41. Castellanos, A., and Pereiras, R. (Bol Soc. cubana de pediat. **14:** 268, 1942)	Female 10 years	Left	Child presumably alive at time of report
	Female 10 years	Right	Child presumably alive at time of report
	Infant 1 day	Left	Ovoid mass 2 × 3 cm. on left side.
42. Gartside, V. O. B., (Brit. J. Radiol. **16:** 69, 1943)	Male 7 years	Left	Child alive at time of report
43. Olcott, C. T., and Dooley, S. M. (Am. J. Dis. Child. **6:** 776, 1943)	Female 2 months	Right	Enlarged left lung. Trachea formed an almost direct line with the left bronchus. Barely recognizable pocket, not over 4 mm. in any dimension, at the normal site of branching of the right main bronchus. No tissue of any sort attached to the external aspect of the bronchus at this point

One normally functioning lung is compatible with and sufficient for life and all ordinary needs, provided the lung remains healthy. The decrease in respiratory reserve is often offset by an increase in pulmonary tissue in the opposite lung, and instances have been reported where six lobes have been present. Compatibility of a single lung with life is further borne

[1] Accepted for publication in August 1943.

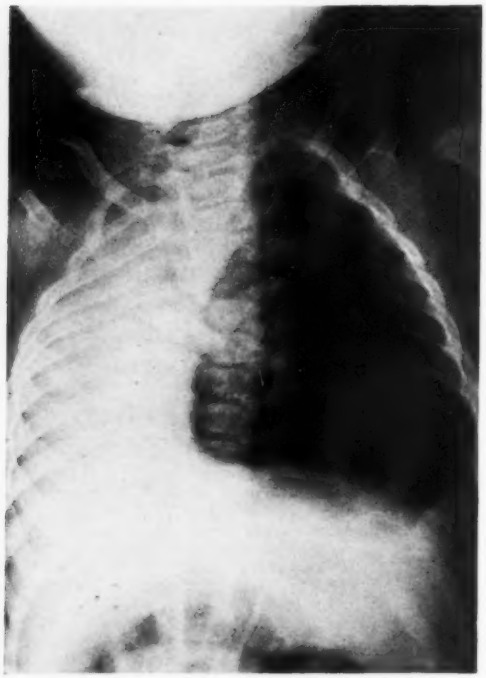

Fig. 1. Agenesis of right lung with wide shift of heart and mediastinum into the right thoracic cavity.

out by the fact that 11 of the cases reported were in patients twenty years of age or older. Herrero (4) reported a case in a man of sixty-five. Van Loon and Diamond's (7) patient was a child three and one-half years old who at the present time is still alive.

Schneider (6) recognizes three main types of pulmonary agenesis. The first type is a true aplasia with no trace of lung, bronchus, or vascular supply on the affected side. The second type is characterized by a small out-pouching from the trachea, with rudimentary bronchus. In the third type the bronchus is fully formed but ends in a fleshy mass of areolar tissue of varying amount.

The different types of pulmonary agenesis may be explained on an embryological basis. The lungs arise at the end of the fifth week as two bronchial buds which evaginate from the primordial trachea. These buds branch, forming the future bronchial tree. Failure of the lung to develop may be due to an abnormality of the anlage of the lung or interference with its development or to regressive changes occurring at any time during the development of an anlage that had a normal beginning.

The left lung seems to be absent more frequently than the right lung. The incidence of the condition is about the same in either sex.

The following case is the second of congenital absence of a lung, seen in this hospital in the last six years (1). Both were diagnosed before death.

CASE HISTORY

J. M., male, aged six months, was admitted to Children's Mercy Hospital, Kansas City, Mo., Nov. 22, 1942, with a history of a cold, with cough and some cyanosis, of eight days' duration. The family history was irrelevant and the developmental history normal. The past history was negative except for a few transient spells of cyanosis.

The child appeared poorly nourished and somewhat cyanotic about the lips and fingers, breathing with some difficulty. Examination of the ears and nose was negative. The pharynx was injected. The chest was symmetrical, with some retraction at the suprasternal notch; coarse râles were heard over the entire chest, and there was dullness to percussion over the right upper lobe with suppressed breathing over the same area. The heart was regular, with no murmurs. There were no abdominal masses. There were no significant findings referable to the skin or genitals. The temperature was 102.4° by rectum; respirations 40.

Admission Diagnosis: Acute bronchitis, pharyngitis, and atelectasis of the right upper lobe.

Sulfathiazole was administered and the child was placed in a croup tent.

A roentgenogram of the chest showed a dense homogeneous opacity over the entire right lung field, with a wide displacement of the mediastinal structures and the cardiac shadow toward the right, the latter lying completely on the right side of the vertebral column. There were complete loss of shadow of the right diaphragm, retraction of the right lung field, a definite narrowing of the interspaces. There was an over-aeration of the entire left lung, with the lung extending across the right side of the chest.

A bronchoscopic examination was performed on Nov. 24. A 4-mm. Jackson bronchoscope was passed with little difficulty. The epiglottis was curved and normal. The vocal cords were slightly injected. The trachea deviated to the right and appeared continuous with the left main bronchus. No opening of the right main stem bronchus could be found.

The mucosa of trachea and left main stem bronchus was injected, and a small amount of thick tenacious secretion was removed. It was believed that a congenital condition was present rather than an acquired one.

The child's condition remained unchanged and a second chest plate was ordered.

Re-examination after an interval of twenty-four hours revealed no change in the appearance of the thoracic structures. The heart and mediastinum were well over in the right thoracic cavity and there was hyperventilation of the left lung. Obviously no air was entering any portion of the right lung. The findings were considered not inconsistent with a true agenesia of the right lung.

The child's condition became much worse and death occurred Nov. 25.

Autopsy was performed by Dr. Nathaniel Soderberg. The usual Y-shaped incision was made from mid-manubrium to the symphysis pubis and the ends curved laterally beneath the clavicles. Examination of the chest showed an absence or autolysis of the lung on the right side. Further examination showed no lung at all on that side. There was a shifting of the mediastinum toward the right. The left lung was present and showed a patchy confluent bronchial pneumonia-like lesion. There appeared to be no bronchus whatever on the right side. The heart was somewhat dilated. The epicardium, endocardium, myocardium, valve rings, and coronary arteries were grossly negative. The rest of the autopsy findings were unimportant.

DISCUSSION

The increased use of routine chest plates in the armed services, among war workers, and particularly among school children, will undoubtedly bring to light more cases of congenital absence of a lung. Agenesis of the lung is a definite clinical entity. Its early recognition will give the patient a much better chance for life. Diagnosis may be made on the basis of x-ray examination, lipiodol injection, and bronchoscopy.

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Hereditary Cleidocranial Dysostosis[1]

MAJOR D. D. SALMON, M.C., A.U.S.

Cleidocranial dysostosis (cleidocranial dysosteogenesis, congenital cleidal dysostosis) is a relatively rare congenital defect of the skeleton characterized clinically by complete or incomplete aplasia of one or both clavicles, delayed ossification of the fontanelles with defective closure of the sutures, and hereditary transmission.

Among the clinical findings by which this condition may be recognized, abnormal mobility of the shoulders is probably the most striking. In severe cases, the shoulders may be made to meet in front. Another finding readily observed is the presence of a median furrow in the frontal bone, with prominent bosses. A history of either of these defects in other members of the family is suggestive of the diagnosis. The roentgenogram offers the final diagnostic criterion.

The head is large and of peculiar contour, with evidence of delayed and incomplete ossification of the bones. As a rule, the frontal and parietal eminences are particularly prominent, with considerable disproportion between the bones of the calvarium and those of the face. The development of the teeth is usually delayed, and tardy eruption of the deciduous set is observed. Late loss of the deciduous teeth with incomplete and deficient replacement by the permanent teeth is rather commonly reported. Faulty implantation, defective enamel coating, deficiency of development of the root portions, impactions, and supernumerary tooth buds, suggesting that the dystrophy is preosseous and predentinal, have been described by several writers.

The disease is usually diagnosed during roentgenographic examination for some other reason, such as trauma or suspected functional abnormality of the shoulder joints. Several cases in which defective implantation of the teeth first drew attention to the condition have been recorded. Patients are about equally divided between the two sexes.

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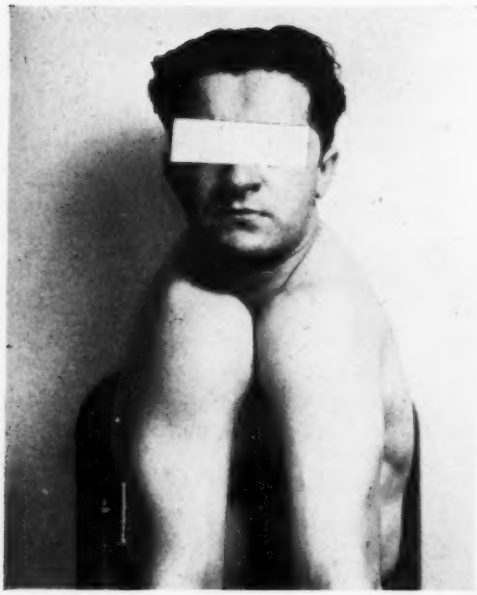

Fig. 1. Photograph of patient showing abnormal mobility of shoulders.

The exact etiology of cleidocranial dystrophy is unknown. That it is preosseous and predentinal in origin, as suggested above, has been emphasized by Anspach and Huepel. Among the etiological factors which have been considered are the occurrence of amniotic bands with hypertension of the amniotic fluid, abnormalities of the germ plasm, injury to the embryo, arrested development, and absence of certain chemical constituents necessary for the calcification of the membranous bones. Of these, the idea of germ plasm abnormalities appears to be the most tenable.

ROENTGENOGRAPHIC FINDINGS

The physical findings previously enumerated are easily confirmed by x-ray, while additional bone defects may be detected only by roentgenographic examination. The nasal sinuses may be incompletely developed or absent. The orbital rims may be incomplete, and there may be an associated hypertelorism. The squamous portion of the temporal bone is rudimentary, and the zygomatic arch is incomplete. Lack of pneumatization of the mastoids may be observed, and persistent mastoid fontanelles may be seen. Prognathism is frequently more real than relative, with associated brachycephaly. Absence or underdevelopment of the nasal and lacrimal bones, with a depressed or flat nasal bridge and a narrow, highly arched palate, is often present.

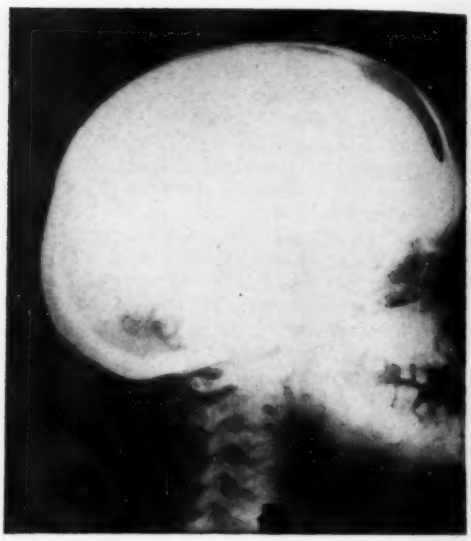

Fig. 2. Lateral view of skull showing slight disproportion between the calvarium and face. The maxilla is underdeveloped and the mandible is slightly suggestive of prognathism. There are marked dental irregularities. The osseous defect in the frontal bone is clearly demonstrated. The squamous and mastoid processes of the temporal bone appear rudimentary and there is no evidence of pneumatization. The sella turcica appears normal. The lambdoidal suture is unfused and numerous wormian bones are seen in it. The atlas appears to be fused to the axis.

The incomplete ossification of membranous bones is observed again in the formation of wormian bones adjacent to the lambdoidal suture. Spina bifida is seen, sometimes with an associated fusion of the vertebral bodies. The pelvis may be deficient, with absence of ossification at the symphysis pubis, blunting of the heads and shortening of the necks of the femurs. Malformation of the joints and phalanges of the fingers has been recorded.

CASE REPORT

L. O. P., a soldier of French-Irish descent, 21 years old, had suffered all his life from severe

headaches after exposure to sunlight and since being in the Army had experienced extreme fatigue and a feeling of weight in the neck and shoulders after calisthenics. When encouraged to describe his complaints, he demonstrated prominent frontal bosses and a "soft spot" in the mid-line of the frontal and parietal bones. Also, he displayed ability to approximate his shoulders anteriorly, explaining that he had no collar bone.

The medical history revealed a normal birth and

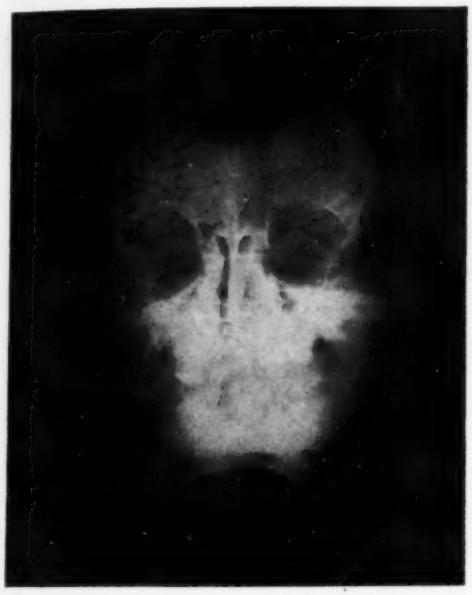

Fig. 3. Postero-anterior nose-chin view showing mid-line defect in the frontal bone. The maxilla is underdeveloped, with vaguely defined rudimentary maxillary sinuses. Note failure of development of frontal sinuses and poorly developed zygomatic arches.

normal childhood, except for late eruption of the deciduous teeth, which were not otherwise extraordinary. When these were lost, late in adolescence, some were never replaced by permanent teeth. Following a bicycle accident in 1940, several roentgenograms had been made at the Shreveport Charity Hospital, Shreveport, La., and there the patient was told about his condition. His father, living and well at the age of 52, was said to have a median furrow in the frontal bone and prominent bosses but no "soft spot" in his head. He could easily approximate his shoulders anteriorly. The patient's mother died when he was rather young, but he had been told that she had none of the bony defects described by him as occurring in other members of his family. One sister, 14 years of age, was said to have very sloping shoulders, which she could bring together in front. She did not have a furrow n the frontal bone, prominent frontal bosses, or a

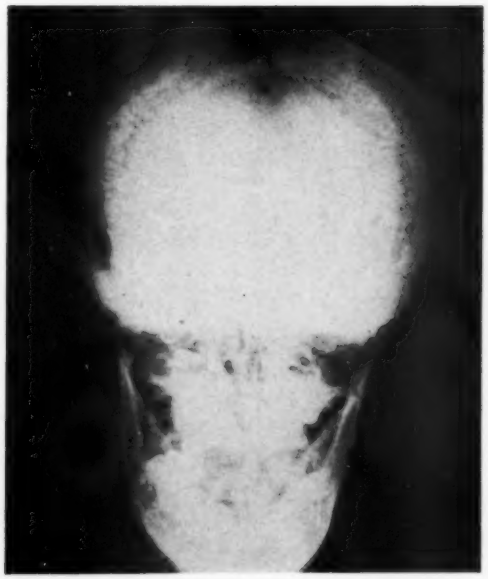

Fig. 4. Postero-anterior nose-forehead view showing bony defect of unossified cartilage corresponding to median frontal furrow, unfused lambdoidal sutures, and absence of frontal sinuses. Teeth are in position of occlusion.

"soft spot" like her brother. No roentgen studies of the father and sister had been made.

The patient was of short, stocky stature, with excellent muscular development, and was intelligent and co-operative. His head appeared large, the calvarium seeming out of proportion to the face. A noticeable median depression extended from the hairline to the root of the nose. The frontal bosses were prominent, and there was a suggestion of prognathism. Only eleven teeth were present, six of which were situated anteriorly. All the teeth were carious in varying degrees. The shoulders were sloping and abnormally mobile, so that the patient could easily approximate them anteriorly (Fig. 1).

The laboratory findings were not significant. The blood and urine were normal. The Kahn reaction was negative.

Roentgenographically a slight disproportion between the bones of the calvarium and face was demonstrable. The latter appeared underdeveloped, as evidenced by small nasal and lacrimal bones. A lateral view of the skull (Fig. 2) showed a small, underdeveloped maxilla, with supernumerary teeth, misplaced teeth, conically formed teeth, and numerous impactions. The maxillary sinuses were small and vaguely defined, suggesting underdevelopment. The mandible appeared normal, with a slight suggestion of prognathism. The same dental irregularities were seen as in the maxilla. There

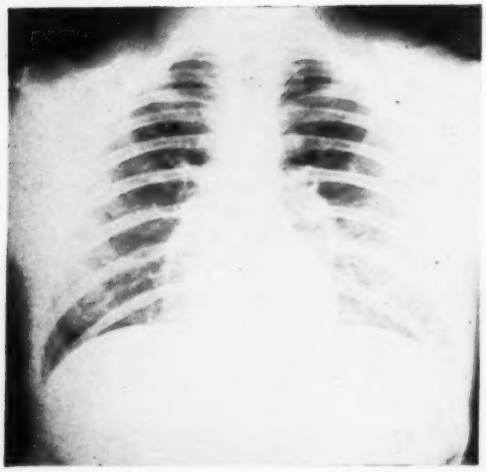

Fig. 5. Postero-anterior view of chest, showing conical rib cage, with almost complete aplasia of the clavicles bilaterally, with small, thin, incompletely ossified rudiments extending from the sternoclavicular articulations. There is a spina bifida occulta of the eighth cervical, first, second, third, and fourth thoracic vertebrae.

was an absence of osseous tissue in the frontal bone in the mid-line, extending from the anterior fontanelle to a point one inch above the supraorbital ridges. The squamous and mastoid processes of the temporal bone appeared rudimentary and no pneumatization was noted. The sella turcica was normal. The lambdoidal suture was open and numerous wormian bones were seen. There appeared to be fusion between the atlas and axis.

A nose-chin view (Fig. 3) confirmed the presence of the mid-line osseous defect in the frontal bone. The underdevelopment of the maxillary bone, irregularities of the teeth, and poor development of the maxillary sinuses. No development of the frontal sinuses was seen. The zygomatic arches bilaterally were rudimentary and poorly defined.

A nose-forehead film (Fig. 4) showed unossified cartilage corresponding to the median furrow visible in the frontal bone on physical inspection. The absence of the frontal sinuses was confirmed, and the unfused lambdoidal sutures were seen. Teeth were seen in the position of occlusion.

Views of the temporal regions showed the mastoids to be of infantile type, with complete absence of pneumatization of any of the mastoid air cells. The squamous and mastoid processes bilaterally were rudimentary and the lambdoidal suture was seen to be open, with persistent mastoid fontanelles and many small, unfused wormian bones.

The view of the chest (Fig. 5) showed a normal heart and lungs. The thorax was conical, with almost complete aplasia of the clavicles bilaterally. Small, thin, transparent, incompletely ossified rudiments of the clavicles were seen extending from the sternoclavicular articulations. There was a spina bifida occulta of the eighth cervical, first, second, third, and fourth thoracic vertebrae.

In the pelvis (Fig. 6) the symphysis pubis showed abnormal separation, measuring about 3 cm. between the anterior ends of the pubic bones, with roughening and irregularity, probably due to absence of ossification. There were blunting of the heads and shortening of the necks of both femurs.

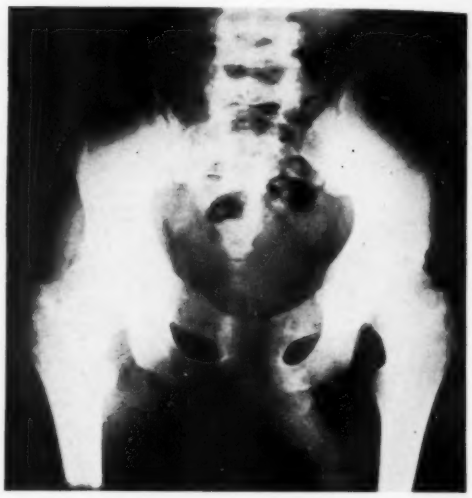

Fig. 6. Pelvis, showing shortening of the necks, with blunting of the heads of the femurs bilaterally. The symphysis pubis shows abnormal separation, with irregular roughening of its anterior portions, apparently due to lack of calcification.

SUMMARY

A case is reported of hereditary cleidocranial dysostosis in a soldier, Characteristic features were partial aplasia of the clavicles, abnormal mobility of the shoulders, failure of the fontanelles to close, and defective union of the cranial sutures. Other bony abnormalities frequently associated with this condition were also demonstrated. The patient's father and a sister showed some but not all of these evidences of the disease.

ACKNOWLEDGMENT: Thanks are due Mr. William A. Cobb, Warrant Officer, Junior Grade, Photographic Officer, Aloe Army Air Field, Victoria, Texas, for the films used in this report.

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Isolated Fracture of the First Rib Produced by Muscular Traction[1]

ROBERT L. GARBER, M.D.[2]

Isolated unilateral fracture of the first rib due to muscular (scalenus anticus) pull is of infrequent occurrence. A review of the literature reveals about 64 reported cases of isolated fracture of the first rib, unilateral and bilateral, due to all causes. Knoepp (5), in a series of 386 cases of rib fractures of all types, found 32 isolated fractures of the first rib, and only 2 of these were due to muscular pull (0.5 per cent of the total series; 6.0 per cent of the first rib fractures). Breslin (2), reporting 5 of his own cases and reviewing 27 others, found 2 cases due to muscular pull (also 6.0 per cent of first rib fractures).

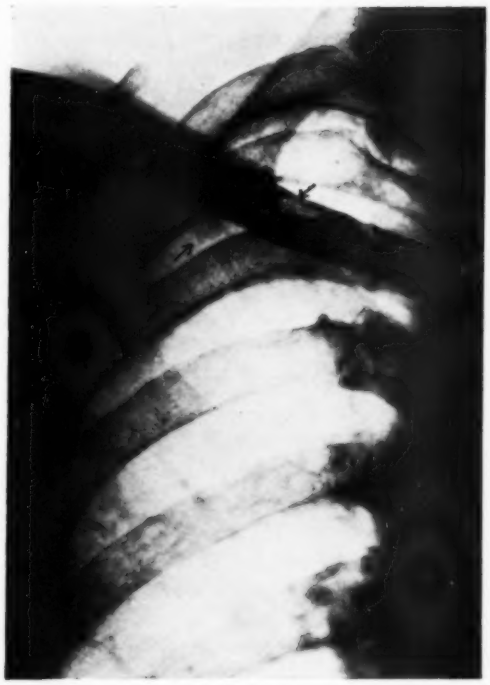

Fig. 1. Fracture of first rib at scalenus anticus tubercle.

The first rib is the shortest in the thoracic cage. It is flat and broad, having two surfaces, which face cephalad and caudad. On the upper surface near its mid-portion is a bony prominence, the scalenus tubercle, the site of insertion of the scalenus anticus muscle. Kellogg Speed (6) says that "the length of the first two ribs and the clavicle usually protect them against fractures, this accounting for their low frequency; rarely muscular action, such as lifting heavy objects, produces fractures." He gives no statistical data.

L. S., white male kitchen helper, age 54, was engaged in lifting a large metallic container holding 15 gallons of milk. He suddenly experienced a

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[2] Radiologist, Mansfield General Hospital, Mansfield, Ohio.

sharp, lancinating pain in the region of his right shoulder, which forced him to drop the container and seek medical attention. On physical examination, he was found to have limitation of motion of the shoulder girdle, with voluntary splinting of the shoulder. No localized tenderness or crepitation could be elicited.

A roentgenogram demonstrated a complete transverse fracture through the anterior medial portion of the first rib on the right, presumably at the scalenus tubercle (Fig. 1). Very slight separation and displacement of the fragments were noted. None of the complications described by Knoepp, Breslin, and others (2, 4, 5) was present and presumably they do not occur in a fracture of the first rib as a result of muscular pull. Treatment consisted of simple immobilization, and an uneventful recovery ensued in three weeks. A follow-up roentgenogram is not available.

A search of the radiological literature fails to disclose any similar case. In reviewing several thousand routine chest roentgenograms of inductees at the local Armed Force Induction Station, this condition was noted as an incidental finding in at least half a dozen instances. Upon questioning, no history of trauma was obtained. Most of the men were farmers or laborers. It is thought that these fractures resulted from lifting heavy objects with consequent traction on the scalenus anticus muscle.

SUMMARY

1. A report of an isolated first rib fracture due to muscular pull is presented and the literature is reviewed.

2. Approximately 64 cases of isolated rib fractures due to all causes were previously recorded. About 6.0 per cent (or 4 cases) were due to scalenus anticus pull.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

"Fatigue" Fracture or "March" Fracture

March fracture, recognized for many years, has under wartime conditions become a subject of renewed interest. It has been found to occur not only in the metatarsals, as the earlier reports would suggest, but in other weight-bearing bones as well. Since 1938, cases have frequently been recorded as occurring in the tibia, fibula, and femur, and more rarely in the pelvis and spine. Most of the earlier writers contented themselves with the designation "march fracture," or simply "march foot," in reference to the occurrence of the condition chiefly among soldiers subject to long and unaccustomed marches. Recently certain writers have used instead the term "fatigue" or "stress" fracture.

Hartley (1) in a recent contribution strongly recommends the name "fatigue fracture." He believes the condition is analogous to the fatigue fracture occurring in metals subject to increasing stresses and quotes Henschen's observation that by spectroradiographic methods exhaustion fractures have been shown to occur in bone under prolonged stress without adequate rest periods. He reserves the term for those cases in which a partial or complete fracture can be shown radiographically in apparently normal bone or in which a submicroscopic or molecular fracture can be inferred from the presence of callus or the subsequent history. There must be no systemic disease present which could cause bone weakness, and there must be no history of violence.

Hartley, like others, calls attention to the curiously low incidence of fatigue fracture in both America and Great Britain, where, until recently at least, only scattered examples have been recorded, in contrast to the large numbers of cases encountered in Finnish, Swedish, Norwegian, and German recruits.

By some these fractures have been confused with the pseudo-fracture of Looser but, as Hartley points out, they are quite different and entirely unrelated. Pseudo-fractures occur in diseased bone; they often involve non-weight-bearing bones; they are multiple, produce only slight callus, and may remain static for months. Fatigue fractures, on the other hand, are found in weight-bearing bones, of normal texture; they are usually single and are characterized by abundant callus, even though the fracture itself may be barely perceptible. The type occurring in the foot usually involves the shaft of the second or third metatarsal, less often the fourth, and rarely the fifth.

Krause (2) divides the syndrome into four stages. (1) During the first week or ten days following the onset of symptoms, the roentgenogram may show only a narrow fracture line or possibly none at all. (2) In from one to three weeks after onset, a spindle-shaped callus formation is seen about the affected area and a fracture line is often visible. (3) Later, after immobilization, the callus is more sharply circumscribed and denser. The fracture line may still be visible. (4) The end-result is a slightly thickened cortex.

Reports from army camps indicate that large numbers of these fractures are now being seen. Krause (3) has encountered more than 200 cases. The consensus of opinion attributes the fracture to repeated mechanical stresses of such character that their summation exceeds the physio-

logical strength of the bone. The onset of symptoms is usually gradual but may be abrupt. In the metatarsal area there is gradually increasing discomfort when the body weight is placed on the foot, which may increase to the point of complete disability. Swelling and edema, especially on the dorsum of the foot, are frequently associated. Treatment is by immobilization and relief of weight-bearing, with gradual return to full activity.

Fatigue fractures do not appear to have been reported in the tibia until 1938, but since that time a number of such cases have been published. Krause (3) reported four examples in soldiers. The most common site appears to be at the junction of the middle and upper thirds of the tibia. The fracture is usually incomplete, but may progress to a complete fracture following a relatively slight injury. There is no soft tissue swelling and no osteoporosis. Most of the callus is seen posteriorly and medially, indicating that bone proliferation tends to follow the line of greatest stress.

Hartley (1) calls attention to the fact that lateral roentgenograms of the tibia indicate that the maximum transmission of weight is posterior to the long axis of the tibia, as the bony architecture shows stress lines to be accentuated in the triangular area behind the mid-point of the internal condyle. These lines meet at the cortex, about 3 inches below the condyle, very near the point of origin of these fractures. This is taken as additional evidence that the fractures are due to bony fatigue or exhaustion.

A case of "fatigue" fracture of the femur has been reported by Peterson (4). This was in a 17-year-old boy, who experienced sudden pain during exercise after a lengthy period of inactivity. A roentgenogram disclosed a slight crack in the femoral cortex. Later a diagnosis of bone tumor was made, but progressive callus formation finally clinched the diagnosis of fracture.

Jones (5), in a recent report, describes "march" fractures of the inferior pubic ramus occurring in three soldiers. They complained of gradually developing pain along the adductor aspect of the thigh following exercise, with no history of trauma. All made satisfactory recoveries following simple bed rest.

A case of "exhaustion" fracture of the spine is reported by Hartley (1), who believes that excessive overloading was the contributing factor. It occurred in a boy 17 years of age who was carrying sacks of coal weighing 100 pounds on his back. The pain came on suddenly and was acute in nature. Roentgenograms showed compression of the 5th dorsal vertebra. This narrowing of the vertebra increased during a one-week interval when there was no attempt at extension of the spine.

The frequent reports of fatigue fractures during the past five years emphasize the role which abnormal stresses play in their etiology. Most of the cases have occurred in recruits in the military service, who were subjected to unaccustomed physical tasks. It should be noted that nearly all of the patients are young persons. Differentiation of these fractures from sarcoma, which has been seriously considered in several of the reported cases, is especially important. Callus formation is a prominent feature and is often out of all proportion to the extent of the fracture. Radiologists must be on their guard to recognize the condition, especially in view of the compensation angle. Finally, a standardized name should be adopted. "Fatigue" fracture, as advocated by Hartley, would seem to be acceptable from both an etiologic and descriptive point of view.

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5. JONES, DEAN B.: March Fracture of the Inferior Pubic Ramus. Report of Three Cases. Radiology **41:** 586–588, December 1943.

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Joint Meeting
The Radiological Society of North America
and
The American Roentgen Ray Society

The Palmer House, Chicago, Ill.
September 24 to 29, 1944

In the March issue of Radiology there appeared a preliminary announcement of a joint meeting of the American Roentgen Ray Society and the Radiological Society of North America to be held in Chicago, Sept. 24 to 29, 1944.

The expressed opinion of those who have been contacted indicates that this meeting will be extremely welcome to all radiologists in the United States and Canada. It will afford a much-needed opportunity for the exchange of views and ideas, as well as constituting a valuable source of information and instruction.

Joint committees have been appointed and it will be their responsibility to arrange for the Commercial and Scientific Exhibits, Refresher Courses, and the Scientific Program. May we suggest that members of both societies make an immediate survey of their material and put forth a consistent effort to contribute either to the program or exhibits.

The Coordinating Committee, consisting of Dr. Lyell C. Kinney (1831 Fourth Ave., San Diego 1, Calif.), Dr. Edward L. Jenkinson (St. Luke's Hospital, Chicago, Ill.), and Dr. Eldwin R. Witwer (Harper Hospital, Detroit 1, Mich.), will be delighted to be of any possible assistance in arrangements. Titles and abstracts of papers should be submitted to Doctor Kinney or Doctor Witwer before July 1, 1944.

Dr. Lawrence Reynolds (10 Peterboro, Detroit 1, Mich.) is Chairman of the Commercial Exhibits Committee. Prospective exhibitors should communicate with Doctor Reynolds for space at an early date.

The Scientific Exhibits Committee, of which Dr. Clarence Hufford (421 Michigan St., Toledo, Ohio) is Chairman, will be in a position to send out application blanks for space in the near future. Those who are planning to present exhibits will find it advantageous to prepare films, charts, graphs, and specimens at the earliest possible time.

Dr. Warren Furey (6844 Oglesby Avenue, S. Chicago Station, Ill.) heads the committee in charge of the Refresher Courses, which will start Sunday, Sept. 24. The combined talent available in the two societies makes it certain that these will be of outstanding character. Doctor Furey should be contacted immediately, so that he may make the most advantageous arrangement of available material in arranging these courses.

We are certain that members of both the Radiological Society of North America and the American Roentgen Ray Society appreciate the importance of this meeting. Their officers and committees solicit their support in making it one of the outstanding radiological meetings of all time.

ELDWIN R. WITWER, *President*
Radiological Society of North America

INTER-AMERICAN COLLEGE OF RADIOLOGY

At the First Inter-American Radiological Congress held in Buenos Aires in October, action was taken authorizing the formation of an Inter-American College of Radiology, with headquarters in Buenos Aires, and the following committee was appointed to organize the body: Dr. Merlo Gómez, Dr. José Saralegui, Dr. Pedro Fariñas (Cuba), Dr. Mata Martinez (Ecuador), and Prof. Carlos Butler (Montevideo).

The next Inter-American Congress was set for 1945, inasmuch as that year marks the fiftieth anniversary of Roentgen's discovery, and Habana, Cuba, was chosen as the probable meeting place.

CANCER TEACHING DAY

Schenectady, N. Y.

A Cancer Teaching Day will be observed April 20, 1944, at Schenectady, N. Y., with a program, presented under the auspices of the Medical Society of the County of Schenectady, the Medical Society of the State of New York, and the New York State Department of Health, Division of Cancer Control.

The speakers at the afternoon meeting, to be held at 3 o'clock at the Ellis Hospital, will be Wm. H. Woglom, M.D., Associate Professor of Cancer Research, Columbia University, and Arthur Purdy Stout, M.D., Associate Professor of Surgery, Columbia University. Dinner will be served at 6:30 P.M. at the Mohawk Golf Club, followed by the evening session. The speakers at this meeting will be Fordyce B. St. John, M.D., Professor of Clinical Surgery, Columbia University, and Hayes E. Martin, M.D. Asst. Professor of Clinical Surgery, Cornell University Medical College.

Dr. Ellis Kellert, Ellis Hospital Laboratory, Schenectady 8, N. Y. is chairman of the committee on arrangements.

In Memoriam

CHARLES FREDERICK BAKER, M.D.

1876–1944

Dr. Charles F. Baker, who died on March 6, 1944, was born in Newark, N. J. Following his graduation from the College of Physicians and Surgeons of Columbia University (1902), he served his internship at the Newark City Hospital and continued the practice of his profession in the city of his birth. He maintained his own x-ray laboratory for many years and played an important role in the advancement of his specialty in New Jersey. He was director of the Department of Roentgenology at the Babies Hospital-Coit Memorial, St. Barnabas Hospital, the Eye and Ear Infirmary, and the Presbyterian Hospital, all of Newark, and of the Orange Memorial Hospital, Orange, N. J.; and consulting roentgenologist at the East Orange General Hospital, East Orange, N. J.

Doctor Baker was a diplomate of the American Board of Radiology, a member of the Radiological Society of North America, and a member and former president of the Radiological Society of New Jersey.

KURT FRIEDRICH BEHNE, M.D.

1885–1944

Dr. Kurt F. Behne, of Los Angeles, a member of the Radiological Society since 1928, died on Jan. 15, 1944. Doctor Behne came to America from Germany, where he received his medical training. He was licensed to practise medicine in California in 1924.

ARCHIE DUNCAN IRVINE, M.D.

1903–1944

Word has been received of the death on Feb. 12, 1944, of Dr. A. D. Irvine of Edmonton, Alberta. Doctor Irvine was graduated in medicine from the University of Toronto in 1931. He was radiologist to the Edmonton General and Misericordia Hospitals in Edmonton and Honorary Demonstrator in Radiology at Alberta University. He was a diplomate of the American Board of Radiology and a member of the American College of Radiology, the Radiological Society of North America, and the Canadian Association of Radiologists.

HENRY P. ENGELN

1870–1944

The following resolution of the Cleveland Radiological Society was ordered at the February meeting, 1944.

"WHEREAS: Death has removed from our Society Mr. Henry P. Engeln, the following brief outline is submitted for incorporation in the records.

"He was born in Paris, France, in 1870 and died at St. Luke's Hospital, Cleveland, Ohio, on February 7, 1944. He came to the United States with his parents, when about 15 years of age; they settled in Chicago, Ill. There he grew into manhood and was in business with his brother, until he came to Cleveland, about the year 1900. Here he engaged in the manufacturing of revolving plate static machines. This first brought him in touch with the x-ray field. He cooperated with Dr. George Iddings, in establishing the first x-ray laboratory in

Cleveland, which was located in the Caxton Building on Huron Road. He continued in this field the rest of his business life. He was associated with several leading x-ray organizations and for many years headed his own, the H. P. Engeln Co. He was always interested in everything pertaining to this branch of medicine. He regularly attended both national and international meetings, was known to hundreds of radiologists and probably knew personally more pioneer radiologists than any other member. Even after retiring from active work a few years ago, he visited and enjoyed being with his old x-ray friends.

"As a Society we wish to extend to his family our sympathy at his passing and assure them we hold fondly the memory of this friendly friend.

"*Therefore:* Be it ordered that a copy of this Resolution be sent to the family, the *American Journal of Roentgenology* and *Radiology*."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE RADIOLOGY OF BONES AND JOINTS. By JAMES F. BRAILSFORD, M.D., Ph.D., F.R.C.P., F.I.C.S., Hunterian Professor, Royal College of Surgeons, England, 1934–35, 1943–44; First President of the British Association of Radiologists; Radiological Demonstrator in Living Anatomy, the University of Birmingham; Honorary Radiologist to the Queen Elizabeth Hospital, Birmingham; Honorary Radiologist to the Royal Cripples' Hospital, and the Warwickshire Orthopaedic Hospital; Radiologist to St. Chad's Hospital, the City of Birmingham Infant Welfare Centres and the Military Hospital, Hollymoor, Birmingham; Consulting Radiologist to the City of Birmingham Hospitals, the Robert Jones and Agnes Hunt Orthopaedic Hospital, the Birmingham Accident Hospital and Rehabilitation Centre, the Birmingham Mental Hospital; Late Radiologist, the Birmingham War Hospitals and Ministry of Pensions Hospitals. Third Edition. A volume of 440 pages with 404 illustrations. Published by J. & A. Churchill, Ltd., 104 Gloucester Place, Portman Square, London, 1944. Price 45 shillings.

PHYSICAL FOUNDATIONS OF RADIOLOGY. By OTTO GLASSER, Ph.D., Professor of Biophysics and Head of Department of Biophysics, Cleveland Clinic Foundation, Cleveland, Ohio; EDITH H. QUIMBY, Sc.D., Associate Professor of Radiology (Physics), College of Physicians and Surgeons, Columbia University, New York; LAURISTON S. TAYLOR, Ph.D., Chief of X-Ray Section, National Bureau of Standards, Washington, D. C.; and J. L. WEATHERWAX, M.A., Philadelphia General Hospital and Graduate School of Medicine, University of Pennsylvania, Philadelphia. A volume of 426 pages, with 95 illustrations and numerous depth-dose tables. Published by Paul B. Hoeber, Inc., New York. Price $5.00.

MEDICAL PHYSICS. Editor-in-Chief, OTTO GLASSER, Ph.D., Head of Department of Biophysics, Cleveland Clinic Foundation; Professor of Biophysics, Frank E. Bunts Educational Institute; Consulting Biophysicist, University Hospitals of Cleveland, Cleveland, Ohio. Associate Editors: *Anatomy:* Normand L. Hoerr, M.D., Ph.D.; *Bacteriology:* Otto Rahn, Ph.D.; *Biometrics:* Charles P. Winsor, Ph.D.; *Biophysics:* Otto Glasser, Ph.D.; *Dermatology:* George W. Binkley, M.D.; *Hematology:* Eric Ponder, M.D., D.Sc.; *Medicine:* Russell L. Haden, M.D.; *Neurology:* W. James Gardner, M.D.; *Nuclear Physics:* Robley D. Evans, Ph.D.: *Ophthalmology:* Albert D. Ruedemann, M.D.; *Optics:* W. B. Rayton, D.Sc.; *Orthopedics:* James A. Dickson, M.D.; *Otolaryngology:* Paul M. Moore, Jr., M.D.; *Pathology:* Harry Goldblatt, M.D., C.M.; *Pediatrics:* Norman C. Wetzel, M.D.; *Photography:* Leo C. Massopust; *Physical Chemistry:* Francis M. Whitacre, Ph.D; *Physical Therapy:* Walter J. Zeiter, M.D.; *Physics (Instruments and Methods):* John G. Albright, Ph.D.; *Physiology:* Harold D. Green, M.D.; *Radiology:* Harry Hauser, M.D.; *Surgery:* Frederick R. Mautz, M.D.; *Urology:* Charles C. Higgins, M.D. A volume of 1,744 pages, with numerous illustrations. Published by The Year Book Publishers, Inc., Chicago. Price $18.00.

METABOLISM MANUAL. By JESSIE K. LEX, R.T., M.T. (ASCP), President Illinois Society Clinical Laboratory Technicians 1942–43, Chief Medical Technologist, Chief X-Ray Technician, the Diagnostic Clinic of George W. Parker, M.D., and George Mason Parker, M.D., Peoria, Illinois. A volume of 56 pages, with numerous charts. Published by The Waverly Press, Baltimore. Price $1.75.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Haig H. Kasabach, Presbyterian Hospital, New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Biliary Tract

The Adrenal Glands

The Skeletal System

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Mechanism of Phonation Demonstrated by Planigraphy of the Larynx. Bruno L. Griesman. Arch. Otolaryng. **38:** 17–26, July 1943.

Planigraphy has been found by the author to be of considerable value in the study of the physiology of the larynx during phonation. Planigrams demonstrating the four phases of sound production are reproduced. All of the planigrams were made at a depth of 2 cm. behind the Adam's apple. They show a gross movement downward of the entire larynx during the production of the low octave sound and a reverse movement upward during the production of the higher notes. The author's studies demonstrate that "the primary function of the larynx as a sphincter valve plays also an important role secondarily in the production of voice."

Before the development of planigraphy, it was difficult to get an idea of the lower aspect of the vibrating vocal cords and the contours of the resonating tubes. The author believes that, in the examination of patients with voice disorders, planigraphy will have the advantage over laryngoscopy and photography of the larynx of showing how the resonating cavities act, and not the vocal cords alone.

The paper is well illustrated.

Sarcoma of the Tonsil. Impressions Made by Seven Cases. C. A. Whitcomb. Arch Otolaryng. **38:** 1–9, July 1943.

The author made a study of 7 cases of sarcoma of the tonsil, which he presents briefly in tabular form, with his observations. This is not a common tumor and should not be confused with squamous-cell carcinoma of the anterior faucial pillar, the most common malignant neoplasm in the region of the tonsil. The latter is a slowly growing tumor, which almost never metastasizes beyond the regional lymph nodes of the neck, and kills by pain and starvation. Sarcoma of the tonsil grows rapidly, spreads quickly and widely, and kills by visceral metastasis. Since small cancers of the anterior pillar can be cured by surgical excision, it is especially important to differentiate between these two types of tumor.

Sarcoma of the tonsil has the same gross characteristics as sarcoma arising in other parts of the body. It appears as a bulky, rapidly enlarging, elastic mass, which displaces adjacent tissue. It cannot be distinguished by physical examination from the other types of neoplasm of the tonsil, namely, squamous-cell carcinoma, lymphoepithelioma, and transitional-cell carcinoma, but requires microscopic examination of an adequate biopsy specimen for its identification. Repeated biopsies may be necessary for a correct diagnosis. All metastases should be located by careful physical and roentgen examinations.

Tonsillar sarcoma and its regional metastases are treated with roentgen rays or radium, or with a combination of the two. The primary tumor receives daily doses of roentgen rays of moderately short effective wave length, in a fraction of the amount which reddens the skin. The radiation is delivered through an intraoral cone and through the skin of the neck overlying the tonsil. The treatments are continued until a diphtheritic membrane covers the tonsil. For radium therapy, radon, confined in tiny lengths of capillary gold tubing with a wall 0.3 mm. thick, may be permanently placed at intervals 1 cm. apart in the tumor and the surrounding tonsil. Seeds may also be used to supplement a smaller dose of roentgen rays than that which causes blistering of the skin. The combined method of irradiation offers the advantages of the diffuse radiation effect of roentgen rays and the more intense local effect of radon seeds.

Metastases in the lymph nodes of the neck are treated with daily fractional doses of roentgen rays, supplemented with gamma radiation if the masses persist. Roentgen radiation may be given for relief of symptoms produced by thoracic, abdominal, and skeletal metastases.

The prognosis in sarcoma of the tonsil is poor, especially if cervical metastases are present before treatment. In the author's series all of the patients died of distant metastases.

THE CHEST

Adequacy of the Photofluorographic Method of Chest Survey. M. W. Mason. Ohio State M. J. **39:** 830–832, September 1943.

The author has found both the 4 × 5-inch and the 35-mm. film photofluorographic methods of chest survey adequate from the standpoints of cost, speed, filing, and accuracy. On the basis of his experience in reading 2,000 4 × 5-inch films and over 250,000 35-mm. films, he states a preference for the former, since the larger size involves less eye-strain and insures more accurate diagnosis.

In two average months at the Great Lakes Naval Station, 41,616 men were examined with 35-mm. film; 317 of these were re-examined by 14 × 17-inch films, and 112 finally referred to the hospital for further study. The original diagnosis was changed in only 16 instances.

A table presents the results of 270,060 examinations with 35-mm. films. The number of abnormal findings was 24,108, of which 18,634 represented pulmonary tuberculosis, active and inactive. The number of rejections for service on the basis of the x-ray findings was 954 or 0.35 per cent.

LESTER M. J. FREEDMAN, M.D.

Interrelationship of Upper and Lower Respiratory Infections, Emphasizing the Routes of Infection. John G. McLaurin. Ann. Otol., Rhin. & Laryng. **52:** 589–597, September 1943.

The author believes that, with the exception of specific types of lung infection—tuberculosis, syphilis of the lungs, pneumonia, and lung abscesses resulting from foreign bodies or from the aspiration of infected tissue or material at operation—85 to 100 per cent of all cases of chronic tracheobronchitis, bronchitis, bilateral bronchiectasis, and peribronchitis are directly dependent upon some type of chronic sinus disease. Chronic sinus disease must consequently be looked upon as a constant menace to the lungs.

The most probable routes by which infection reaches the chest from the diseased sinuses are as follows: (1) direct aspiration of infectious material into the trachea and bronchial tree, so-called aspiration or droplet infection; (2) lympho-hematogenous extension; (3)

hematogenous extension; (4) direct continuity of tissue. Usually a combination of routes is involved.

To demonstrate the role of aspiration infection, the author twice injected the ethmoids and sphenoids with lipiodol, with a twenty-four-hour interval. A film of the chest immediately after the first injection showed lipiodol in the bronchi, and twenty-four hours later some of the material was still demonstrable in the smaller bronchioles. This experiment, conducted on patients up and "about their business," would indicate that the larynx is not always effective in blocking the course of a foreign material. This being the case, it seems reasonable to assume that mucopurulent material, manufactured by the patient's own tissues, would even more readily find its way from the postnasal space into the bronchial tree.

Experiments by others have demonstrated the lympho-hematogenous route of infection (Mullin and Ryder: Laryngoscope **31:** 138, 1921), but experimental studies on hematogenous spread do not seem to have been conducted. Infection by direct continuity is believed to be less common than by the other routes.

STEPHEN N. TAGER, M.D.

Tuberculous Tracheobronchitis. David McCullough. Dis. of Chest **9:** 448–454, September–October 1943.

The author quotes Alexander's figure (J. Thoracic Surg. **11:** 308, 1942) of 11 per cent as representative of the incidence of tuberculous tracheobronchitis in pulmonary tuberculosis. Acute lesions may be hyperplastic, ulcerative, or both. The chronic lesion is a smooth fibrostenosis. Smaller bronchi leading from cavities are almost uniformly involved, while the larger bronchi and trachea may be the site of disease varying from a slight area of mucosal redness to ulceration and fibrous stenosis. Following the healing of an ulcerative lesion which has partly destroyed the cartilage, a portion of the bronchus may be relatively flaccid, with the result that during the expiratory phase the bronchial wall collapses, impeding the passage of air. The problem of tuberculous tracheobronchitis is thus one of mechanical obstruction and improper drainage of secretions distal to the site of the disease. The latter may be due to loss of ciliary action and impairment of bronchial peristalsis as well as to mechanical obstruction. Obstructive emphysema, atelectasis, and bronchiectasis may supervene.

One of the chief symptoms of tuberculous tracheobronchitis is severe and often paroxysmal cough: expectoration may be scanty and mucoid, later abundant and purulent, with persistent streaking. Wheezing, asthma-like attacks, intermittent fever, dyspnea and cyanosis may occur.

The roentgen findings are usually indirect: atelectasis, check valve cavities with fluid levels, localized emphysema, spontaneous closure of cavities, unexplained spread of disease in the absence of cavitation. Mural involvement of a larger bronchus, encroaching upon the lumen, may be demonstrated by bronchography. A positive diagnosis can be made only by bronchoscopy, but a negative bronchoscopy does not exclude the possibility of disease in the smaller bronchi.

Local treatment through the bronchoscope is sometimes effective in the ulcero-hyperplastic type of lesion. Lobectomy, pneumonectomy, and thoracoplasty have been advocated in stenotic lesions.

HENRY K. TAYLOR, M.D.

Primary Atypical Pneumonia, Etiology Unknown. John H. Dingle et al. War Med. **3:** 223–248, March 1943.

This paper, which is a report of clinical, epidemiologic, and etiologic studies of atypical pneumonia at Camp Claiborne by the Commission for the Investigation of Atypical Pneumonia and Other Respiratory Diseases, is based on 69 cases observed by members of the Commission and 216 cases abstracted from hospital records. The results of these studies are in general agreement with the observations of other investigators. The disease is characterized by gradual onset, moderately severe constitutional and respiratory symptoms, minimal physical signs in the lungs, and a febrile course of approximately one week's duration. The infection occurs in epidemic and in endemic form. The causation has not been ascertained; on the basis of this investigation it seems most likely that a virus is responsible.

The most characteristic feature of the syndrome, clinically, was the late development of physical signs in the lungs, in contrast to the comparatively extensive roentgen findings. The first change to be noted, early in the course of the illness, was an increase in the size of the hilar shadow, unilaterally or bilaterally. Perihilar infiltration became increasingly apparent in subsequent films, and the shadow then extended toward the periphery of the lung field in either a wedge or a fan shape, usually fading into the normal parenchyma of the lung before reaching the periphery. Spread of the lesion often occurred within a lobe or to an adjoining lobe, but rarely was an entire lobe involved. In some instances the process appeared to be confined to a local area, such as a portion of an upper lobe; in others diffuse seeding of one or both pulmonary fields occurred. In still others infiltration extended along a septum and appeared to be limited by it or was diffuse and became irregularly confluent.

The infiltration usually appeared to be soft and either patchy or homogeneous in character; the greatest density was near the hilus. The pulmonary markings were usually visible, although the outlines of the vascular and bronchial shadows were frequently indistinct. The degree of change in the roentgen appearance of the lesions over a period of a few days was one of the most striking features. Occasionally the lesions were transitory and were seen for only three or four days. Usually, however, the lesion progressed as described and then underwent slow resolution over a period varying from one to three weeks. The enlarged hilar shadows and increased pulmonary markings occasionally persisted for several weeks.

Virus Pneumonia: Etiological Studies. Monroe D. Eaton. California & West. Med. **59:** 160–162, September 1943.

The designation "atypical pneumonia" is generally used to denote a primary pneumonitis or bronchopneumonia without known bacterial etiology. In only about 10 per cent of all cases is a causative virus demonstrable, and it is with this group that the present paper is concerned. Four types, each dependent upon a different virus, are recognized.

Pneumonia may be produced by (1) either of two antigenically distinct viruses of influenza, designated A and B; (2) by the virus of Q fever, of rickettsial origin; (3) by the psittacosis virus; (4) by a virus isolated by the author from cases of severe atypical

pneumonia. Influenzal pneumonia caused by the type A virus, so far as is now known, occurs only in association with epidemics of uncomplicated influenza due to the same virus. The occurrence of Q-fever pneumonitis in the United States is limited to laboratory infections, while the psittacosis type is associated in most instances with contact with infected birds.

The virus isolated by the author is a member of a group which includes not only the psittacosis virus but also the virus of lymphogranuloma venereum, that of meningopneumonitis, and that of mouse pneumonitis recently isolated by Nigg (Science **95:** 49, 1942). The members of this group are characterized by the formation of minute coccoid elementary bodies, by the possession of common antigenic components, and by similarities in pathogenicity for experimental animals.

Despite the fact that the complement-fixation test with this group of viruses was not specific for any one member of the group, when applied to human serum, the author considered it of interest to determine what proportion of cases of atypical pneumonia and of uncomplicated upper respiratory disease gave the reaction. For this purpose, antigens from the viruses of lymphogranuloma venereum and meningopneumonitis were used. In 5 of 17 cases of pneumonitis tested with the virus of meningopneumonitis the convalescent serum showed a definite increase in titer of 8-fold or greater over the serum taken in the acute stage of the illness. Similar definite increases were observed in 6 out of 61 cases tested with the virus of lymphogranuloma venereum. In other cases increases in titer of lesser degree were observed. One case of upper respiratory disease with influenzal symptoms showed a definite increase in titer with both antigens. This case gave negative serological tests for influenza types A and B. In a few other cases of upper respiratory disease slight increases were observed.

Pneumonia attributable to the author's virus appears to be of rare occurrence. The virus was isolated from only 2 out of 106 sputum specimens, and 3 of 14 specimens of lung tissue inoculated into mice intranasally. No transmissible agent could be found in sputum from a number of patients whose serum gave positive reactions with meningopneumonitis antigen.

MAURICE D. SACHS, M.D.

Primary Atypical Pneumonia and Malaria. Edgar T. Campbell. War Med. **3:** 249–255, March 1943.

Primary atypical pneumonia is frequently complicated by a concurrent malaria in localities where the latter disease is endemic. Fifty cases in which the two diseases occurred in association are reported by the author. Some patients who are admitted to the hospital with primary atypical pneumonia are subsequently found to have a blood smear positive for malarial parasites; others are admitted for malaria and later have atypical pneumonia.

In the first group, the onset is usually gradual; there may be a non-productive cough, vague pains in the chest, sore throat, and intermittent fever. The temperature averages between 100 and 102° F. Positive physical signs throughout the illness remain at a minimum. A roentgenogram is necessary for an early and accurate diagnosis of atypical pneumonia. Approximately 68 per cent of the patients in this group had blood smears positive for malaria parasites. This "secondary infection" seemed to have little or no effect on eventual recovery except that longer hospitalization was required to eradicate the parasite than for the pulmonary infection alone.

Patients of the second group are usually admitted to the hospital complaining of a sudden onset of chills and fever or one of the other manifestations of beginning malaria. Blood smears are found to be positive for malarial parasites and antimalaria therapy is begun. During convalescence, a non-productive cough may develop, with pain and discomfort in the chest and elevation of temperature. Examination may or may not reveal positive physical signs in the chest. The diagnosis of atypical pneumonia is made by roentgen examination. As in the first group, each disease runs its independent course, with little effect on the eventual recovery of the patient.

Roentgenologic Appearance of "Bronchiogenic" Cysts. Laurence L. Robbins. Am. J. Roentgenol. **50:** 321–333, September 1943.

Bronchiogenic cysts are usually incidental findings and only occasionally produce symptoms. Fifteen proved cases were selected by the author from the records of the Massachusetts General Hospital, and the case reports are given. The difficulty of diagnosis is shown by the fact that in only 4 of the 15 was the correct diagnosis suggested in the preoperative roentgenologic report. Preoperative differentiation from lung abscess, encapsulated empyema, neurofibroma, dermoid, lymphoma, and malignant tumor is difficult, and in some instances impossible.

The roentgenologic examination should always include roentgenoscopy. At least postero-anterior and lateral views of the chest are necessary. Barium examination of the esophagus is important. It should be remembered that cysts, even if lying within the mediastinum, may show a fluid level, as a bronchus often connects with the cyst. In such cases the roentgenologic appearance of a fluid-and-air-filled cavity suggests a lung abscess. The cyst may alternately fill with fluid or drain and contain air.

The roentgen diagnosis of bronchiogenic cysts is dependent (*a*) on the finding of a smooth, round or ovoid mass arising from the mediastinum without evidence of bone erosion or calcifications within the wall. Additional proof may be found in the demonstration of tracheal attachment or intramural, extramucosal involvement of the esophagus. (*b*) Those cysts which are infected simulate lung abscess in appearance.

Because of the difficulty in diagnosis and the technical difficulties after infection has developed, operative interference is generally recommended.

CLARENCE E. WEAVER, M.D.

Bronchogenic Carcinoma. Foster Murray. Dis. of Chest. **9:** 383–402, September–October 1943.

The author believes there has been a definite increase in the occurrence of primary pulmonary malignant tumors, the majority of which are carcinomas of bronchogenic origin. They occur most often between the ages of 40 and 60, and predominantly in males (8 to 1). The neoplasms are invasive, destructive, and obstructive, with a tendency to ulcerate, erode, become infected, and metastasize. There are three types: (1) squamous-cell (epidermoid, epithelioma), accounting for about 42 per cent; (2) small-cell (including the undifferentiated-cell, oat-cell, and transi-

tional-cell types), comprising about 33 per cent; (3) adenocarcinoma, representing the remaining 25 per cent.

Chronic irritation supervening upon a constitutional defect is given as the etiologic factor. The symptoms, which depend upon the size, location, and type of the new growth, include cough and expectoration, pain, dyspnea, wheeze, anorexia, loss of strength and weight, fever, hemoptysis, pressure effects, anemia, cachexia, secondary infections, and suppuration. Pleural effusion appears in about one-third of the cases. The onset is usually insidious, though it may be rapid and mistaken for a pneumonia.

Metastasis occurs to the regional lymph nodes (tracheobronchial, paratracheal, supraclavicular, cervical, and axillary), and to liver, lungs, bones, kidneys, adrenals, pleura, brain, and female pelvic adnexa.

Points to be observed on fluoroscopic examination are (1) elevation of the diaphragm on the side of the tumor, (2) paradoxical movement of the diaphragm, (3) mediastinal shift during respiration, (4) absence of expansile pulsation if the mass is adjacent to the aortic arch, and (5) effusion. Roentgenograms reveal the site and size of the mass and the presence of bronchial occlusion, effusion, and metastases. Bronchography will localize the closed bronchus, and tomography may be helpful, not only in clearly delineating the mass or the cavity within it, but in more definitely locating the position of the growth relative to the anteroposterior planes.

Bronchoscopy may reveal a fixation of the mediastinum, widening of the carina, deformity of the bronchial walls, and an endobronchial mass. It also provides the best and safest means of obtaining a biopsy specimen.

Other aids in arriving at a diagnosis are lung puncture—though this is condemned by some clinicians—pneumothorax and thoracoscopic exploration, and biopsy of a superficial node. Exploratory thoracotomy is justifiable when other methods of obtaining biopsy material have failed.

The group of squamous-cell tumors is the only one which offers any measure of success following lobectomy or pneumonectomy. HENRY K. TAYLOR, M.D.

Byssinosis—Report of Two Cases and Review of Literature. H. Leonard Bolen. J. Indust. Hyg. & Toxicol. **25:** 215–224, June 1943.

Byssinosis is the term used to identify a form of respiratory disease affecting workers in cotton mills, where much dust is given off in the early processes of preparing the cotton for spinning and weaving.

The onset of byssinosis is insidious. The victim sneezes frequently, has a slight, dry, increasingly irritating cough and is aware of a feeling of constriction in the chest. There is a rise in temperature (101–103°), which may last for two or three days, and dyspnea occurs. The appetite remains good; the patient sleeps well and is able to work. Symptoms are more acute on Mondays, when the worker resumes his dusty occupation after 36 hours in a clean atmosphere.

As the fine particles of cotton become lodged in the lungs, an irritation is set up, the breathing becomes more labored, and the cough more metallic. Expectoration is difficult. The worker becomes easily fatigued and is forced to refrain from work several days at a time. When out of the dusty atmosphere, improvement is rapid.

The disease progresses, with individual variation, over a period of years. As the cotton dust makes its way into the finer bronchi, there is a considerable decrease in vital capacity. The victim becomes a semi-invalid and is forced to give up work. Prolonged exhausting attacks of coughing and the sensation as of a constricting band about the chest cause weakness and loss of weight. As the action of the diaphragm becomes restricted, the sternum becomes prominent, and the chest assumes a barrel shape. The clinical picture is that of severe bronchitis and emphysema.

X-ray films in cases of byssinosis are rare, as investigation of this condition has been recent. In both of the cases here reported, roentgen examination of the chest showed extensive fibrosis. The roentgenograms are reproduced.

There is no specific treatment for byssinosis. Removal from exposure should be the first step, if the worker appears to be susceptible, and symptomatic or preventive treatment should be instituted. In the last stages of the disease, treatment can be only palliative, because irreversible structural changes have taken place in the lungs. Precautionary measures should be taken in textile plants to control card-room dust. Workers should be examined periodically, and those showing pulmonary symptoms should be advised to seek work in another environment.

A bibliography is appended.

Study of Industrial Workers Exposed to Sulfur Dust. Sherman S. Pinto, R. Alec Brown, and B. Hardy Carlton. J. Indust. Hyg. & Toxicol. **25:** 149–151, April 1943.

A study was made of the workers in a sulfur mine employing 500 people. Although the only employees of this company who are exposed to sulfur dust in appreciable amounts are those who remove the material from stockpiles and load it onto barges and those who handle it at the point of transshipment, it was decided to x-ray all employees. The examination was entirely voluntary, and some workers were not studied. Of the latter group, however, none was exposed to sulfur dust. Chest x-rays with a 35-mm. photofluorographic unit were made of 430 people. Each person showing any lung abnormality was re-examined, using a 14 × 17-inch film, with no significant differences in the findings. Among the workers exposed to appreciable amounts of sulfur dust for a period of seven years, no lung lesions were found on x-ray examination which could be attributed to inhalation of the dust.

Agenesis of Lung in an Infant. Charles T. Olcott and Samuel W. Dooley. Am. J. Dis. Child. **65:** 776–780, May 1943.

A case of complete absence of the right lung in a female infant 2 months old is reported. From birth, a gurgling sound was noticed with respiration, and there was pronounced retraction of the sternum and ribs on crying. The thorax was normally formed and symmetric but there was a respiratory lag on the right side. The trachea appeared to be deviated to the right of the mid-line, and percussion demonstrated dullness throughout the right hemithorax. No adventitious sounds were heard except an occasional tracheal gurgle. The point of maximum intensity of the heart beat was at the right nipple and the electrocardiogram showed changes considered compatible with displacement of

the heart. On roentgenographic examination, the cardiac silhouette and mediastinal contents were found in the right side of the chest, continuous with the shadow of the liver. The right bronchus was not demonstrable. Bronchoscopy confirmed its absence and that of the carina. The child died of pneumonia, and autopsy confirmed the diagnosis of pulmonary agenesis. No right pleural cavity was present.

The authors review the literature and call attention to the fact that major anomalies in the respiratory system are less frequent than in the kidneys, genital organs, or digestive tract. In over 10,000 necropsies at the New York Hospital, including many performed on newborn infants, there has been no previous instance of absence of a lung. About 52 cases of complete absence of one lung have been adequately described in the literature.

Thymic Tumor in Myasthenia Gravis: A Case Report. Elmer Haynes. Wisconsin M. J. **42:** 932–933, September 1943.

A case of myasthenia gravis is reported in a 42-year-old man, proved clinically by relief of eye muscle symptoms 15 minutes following the subcutaneous injection of 3 mg. of prostigmine and 1/150 gr. of atropine sulfate. No chest roentgenogram was made since no abnormal chest signs were present. After six years of fairly good health under treatment, the patient was readmitted to the hospital in a semicomatose condition and died. Autopsy showed a soft, gelatinous, cystic mass measuring 17 × 10 × 8 cm. in the thymic area, with several similar nodules, up to 0.7 cm. in diameter, on the right pleura. Microscopic examination showed proliferation of reticulo-endothelial cells, areas of small lymphocytes, and atrophied thymic tissue. Striated muscle sections showed atrophy, hyaline degeneration, and patches of lymphocytic infiltration.

In view of the favorable results reported following the use of roentgen therapy and thymectomy, it is suggested that chest roentgenograms be made routinely in all cases of myasthenia gravis. A negative roentgenographic report does not, however, necessarily rule out thymic enlargement.

LESTER M. J. FREEDMAN, M.D.

Roentgenologic and Electrocardiographic Changes in the Normal Heart During Pregnancy. A. Gerson Hollander and J. Hamilton Crawford. Am. Heart J. **26:** 364–376, September 1943.

A survey was undertaken on healthy women in order to determine whether the enlargement of the cardiac shadow frequently observed in pregnancy is due to cardiac hypertrophy with or without dilatation, or to rotation and displacement. The women were under observation both during and after pregnancy. Roentgen examinations of the chest in the postero-anterior, right and left oblique projections, and esophagrams were made every three months during pregnancy, and again one or two months post-partum. Electrocardiographic tracings were made at four-week intervals, using the two-string electrocardiograph, recording simultaneously Leads I and III. The findings in 18 cases are given.

The most outstanding changes in the electrocardiogram were confined to Lead III. A prominent and, at times, deep Q wave and inversion of the T wave were present in 5 cases, and the T wave became negative and then positive post-partum without alteration of the Q wave in 4 cases. No abnormalities of QRX or the RS-T segments appeared. Although there was no absolute or invariable rate of electrical axis deviation, there was nevertheless a tendency to a shift toward the left during the first and second trimesters of pregnancy, followed by a swing to the right.

The most frequently observed roentgen abnormality was encroachment upon the anterior surface of the esophagus in the region of the left auricle. In the majority of cases the esophagus as a whole was not displaced but a definite indentation of the anterior wall was seen. This finding usually disappeared after the thirty-fourth week of pregnancy. Straightening of the left border of the cardiac silhouette was observed in 2 instances, prominent pulmonary conus in 3, and elevation of the left main bronchus in one.

The authors attribute the roentgen changes observed during pregnancy to an increase in blood volume within the heart, and not to cardiac hypertrophy. The electrocardiographic changes are explained as the result of a positional shift. HENRY K. TAYLOR, M.D.

Heart Size and Pulmonary Findings During Acute Coronary Thrombosis. Edward Massie and Wallace C. Miller. Am. J. M. Sc. **206:** 353–360, September 1943.

Sixteen cases of undoubted acute coronary thrombosis were studied by teleroentgenograms taken at frequent intervals following the acute attack, with particular reference to the size of the heart and the presence of pulmonary congestion. All films were made at a distance of 5 feet, with the patient sitting up. The cardiothoracic ratio was used as a measurement of heart size. All patients were studied by roentgenkymography on the twenty-eighth day after admission. Careful clinical observations, electrocardiograms, blood pressure readings, blood counts, and other pertinent data were obtained in all cases. Excluding 2 cases in which death occurred at the end of the first week, the observations ranged from three to seven months after the attack.

Twelve of the patients had anterior, and the remainder posterior, wall infarctions. Eight had enlarged hearts initially; in 5 the hearts were at the upper limits of normal and in 3 unquestionably normal. Six of the kymograms showed decreased pulsations at the left border near the apex.

No consistent changes in cardiac size or shape were noted. Eight patients showed no change in any film of the entire series. In each of 4 other cases one film showed cardiac measurements significantly different from others of the series. These were taken at greatly varying intervals; some showed increasing and others decreasing measurements.

In the important first two weeks following the thrombosis only 4 patients showed a change in cardiac measurements, an increase in 2 and a decrease in 2. It may be significant that complications occurred more frequently in the group showing a change in heart size; these patients were somewhat more ill than the others.

Only 4 of the patients had clear lungs roentgenographically. The rest showed either fine or coarse diffuse mottling, usually at each base, or definite cloudiness in one or both bases. The pulmonary congestion was usually maximal in the first week and tended to decrease or disappear in the second. In only half of these patients could râles be heard.

BENJAMIN COPLEMAN, M.D.

Roentgen Signs of Patent Ductus Arteriosus: Summary of 50 Surgically Verified Cases. Mark S. Donovan, Edward B. D. Neuhauser, and Merrill C. Sosman. Am. J. Roentgenol. **50:** 293–305, September 1943.

The roentgen findings in 50 cases of patent ductus arteriosus which were verified by operation are presented. These findings, in order of frequency, are: (*a*) dilatation of the pulmonary artery: (*b*) cardiac enlargement; (*c*) dilatation of the left auricle; (*d*) engorgement of the intrapulmonary vessels; (*e*) exaggerated pulsation of the left ventricle and the pulmonary artery; (*f*) "hilar dance," or pulsation of the vessels in the hila of the lungs.

As in all types of heart disease, roentgenoscopy is the most important part of the roentgen study and should precede the making of roentgenograms. A teleroentgenogram should be taken in the posteroanterior projection, as well as roentgenograms in both the left and right anterior oblique positions. A roentgenkymogram may give added information and will be of value for comparison with postoperative kymograms giving evidence of the relatively calm left ventricle after ligation.

The largest hearts were seen in patients with subacute bacterial endocarditis or endarteritis. The rest had no enlargement or only slight to moderate enlargement, limited to the left side. A dilated left auricle is one of the commonest signs of a patent ductus arteriosus and in the authors' experience is exceeded in frequency only by cardiac enlargement and enlargement of the pulmonary artery. An enlarged pulmonary artery is one of the most frequent signs of congenital heart disease and it was present in the majority of the cases in this series. Marked enlargement is seldom seen. A large pulmonary artery, especially if combined with a fairly marked or extreme enlargement of the heart, is apt to be due to a combination of congenital anomalies. Accentuated pulsation of the left ventricle and the pulmonary artery was seen in about two-thirds of the cases. Angiocardiographic studies were carried out in 5 cases. In no instance were the authors able to visualize the ductus arteriosus. Evidence of recirculation of the dye through the pulmonary vessels was, however, obtained.

Roentgenoscopy and kymograms after closure of the ductus will show a reduction of the ventricular pulsation to the normal amplitude, the pulmonary artery no longer enlarged and pulsating, absence of hilar dance, and the left auricle either reduced in size or normal. There is seldom any great decrease in the transverse diameter of the heart.

The authors conclude that a patent ductus arteriosus can now be safely ligated or completely divided, which places it among the curable forms of heart disease. Its accurate diagnosis is therefore vastly more important than it formerly was.

CLARENCE E. WEAVER, M.D.

Angiocardiography in Congenital Heart Disease: III. Patent Ductus Arteriosus. M. F. Steinberg, A. Grishman, and M. L. Sussman, Am. J. Roentgenol. **50:** 306–315, September 1943.

Twenty-seven cases of patent ductus arteriosus were studied by means of angiocardiography. The method employed called for the rapid intravenous injection of 70 per cent diodrast solution (Winthrop), as described by Robb and Steinberg (J. Clin. Investigation **17:** 507, 1938). The position of choice for roentgen examination was found to be the left anterior oblique, 50 to 70 degrees.

The following deviations from the normal were observed: (1) a distinct localized dilatation of the descending aorta just beyond the isthmus (a small bulge or a more or less uniformly dilated segment may be seen); (2) an elevation of the main and left pulmonary arteries; (3) dilatation of the main and major branch pulmonary arteries; (4) varying degrees of left ventricular dilatation.

Of the 27 cases of patent ductus arteriosus studied angiocardiographically, 26 showed the aortic abnormality described. Twelve of these cases were proved at operation. This abnormality has not been seen by the authors except in patent ductus arteriosus. It is therefore probably characteristic of that condition. The persistence of the aortic dilatation after operation might be interpreted as indicating the presence of a traction aneurysm. (The ductus is a short structure, usually no longer than 1 cm.) Prominence of the pulmonary artery segment in the conventional roentgenogram does not always indicate dilatation of the pulmonary artery. Elevation of the pulmonary artery may by itself account for this appearance.

CLARENCE E. WEAVER, M.D.

Constricting Double Aortic Arch: Report of a Case. Peter A. Herbut and Thomas T. Smith. Arch. Otolaryng. **37:** 558–562, April 1943.

A case of a constricting double aortic arch incompatible with prolonged life is reported.

A girl aged 2 1/2 months was admitted to the hospital with a history of increasing respiratory difficulty. Physical examination revealed nothing of significance and roentgen studies showed a normal chest with little or no increase in the breadth of the upper mediastinal shadows. On the third day of hospitalization, while feeding, the infant was seized with a severe attack of coughing and dyspnea. After this, some indrawing of the suprasternal and intercostal spaces persisted, and the respirations never again became entirely normal. The child lay with her head turned to the left at all times. When the head was forcibly turned to the right, her breathing became more difficult and indrawing was marked. When she was placed in the Boyce position preparatory to direct laryngoscopic examination, increased respiratory difficulty was noted. Upon extension of the head, in order to introduce the laryngoscope, respiration ceased entirely, indicating increased tracheal obstruction. The larynx, however, appeared normal. After laryngoscopy, respirations began only when the child was held with the neck extended and with flexion of the head on the neck. A low tracheotomy was performed, several cubic centimeters of thick pus were aspirated, and the patient experienced some relief. When a small rubber aspirating catheter was passed through the tracheotomic cannula, an obstruction was encountered below the end of the cannula, about 1 cm. below the suprasternal notch. The catheter would pass this narrowing only with difficulty. Death occurred on the second day following tracheotomy, the fifth day of hospitalization.

Necropsy revealed the ascending aorta anterior to but slightly to the right of the trachea. At its superior portion it bifurcated into a larger right and smaller left aortic arch, measuring 1.0 cm. and 0.5 cm. in diameter, respectively. Each was directed dorsally,

lateral to the trachea and esophagus and superior to the hilus of the corresponding lung. Posterior to the esophagus the arches united, forming a complete arterial collar encircling the trachea and esophagus. The descending aorta was situated slightly to the left of the mid-line. The great vessels of the neck and upper extremities arose almost symmetrically from each arch. There was no innominate artery.

The author believes that when symptoms and findings such as were present in this case are encountered, the possibility of a constricting double aortic arch should be kept in mind, as the roentgenologist, once his attention is directed to this unusual condition, can offer considerable aid in diagnosis. He not only can rule out most other possible causes but will be able to demonstrate a number of rather conclusive features. The broadening of the superior mediastinal shadows, often very slight, can be investigated thoroughly. The esophageal constriction at the level of the arotic arch is the most constant and the most informative manifestation. This is best demonstrated by flucroscopic studies of the swallowing function followed by roentgenograms of the outlined esophagus. Esophagoscopic examination is contraindicated. If an early diagnosis is made, the possibility of successful surgical treatment is suggested.

Tetralogy of Fallot. Irwin Feigin and Julius Rosenthal. Am. Heart J. **26:** 302–312, September 1943.

The postmortem findings are given in two cases in which the hearts showed changes constituting the tetralogy of Fallot, namely, right ventricular hypertrophy, pulmonic stenosis, interventricular septal defect, and dextroposition of the aorta.

The first patient died at the age of 53. His history would lead one to believe that there was no pulmonic stenosis prior to the age of 37, although the other changes were manifestly congenital. Rheumatic pulmonic valvulitis, acquired late in life, resulted in a pulmonic stenosis, completing the tetralogy. The complex of congenital cardiac abnormalities displayed by this patient, before development of acquired pulmonic stenosis is known as the Eisenmenger complex. It is less common than the complete tetralogy, and the associated functional changes are of less serious prognostic significance.

The second patient died at the age of 43. The changes apparently had been present since birth. A communication also existed between the auricles, and a fibrous strand representing the remnants of a patent ductus arteriosus was found.

The cardiodynamics in the two cases are discussed.

HENRY K. TAYLOR, M.D.

Treatment of Dysphagia from Hernia Through Esophageal Hiatus in Diaphragm. Porter P. Vinson. Arch. Otolaryng. **38:** 27–31, July 1943.

The purpose of this paper is to call attention to two types of diaphragmatic hernia, through the esophageal hiatus, in which dysphagia is often the predominating symptom. These two types of hernia are the paraesophageal and the so-called short esophageal.

In the paraesophageal type of hernia, the esophageal opening in the diaphragm is larger than normal, and a portion of the stomach, usually the fundus, protrudes alongside the esophagus into the thorax. At first this abnormality may not produce symptoms but, because of the negative intrathoracic and positive intra-abdominal pressure, more and more of the stomach is sucked and pushed into the thorax, so that eventually symptoms occur.

In patients with the so-called short esophageal type hernia, the esophagus is usually about 2 inches shorter than average. It does not reach the diaphragm, and in the process of growth a portion of the stomach develops within the thorax.

Roentgenoscopy is almost indispensable in the diagnosis of hernia through the esophageal hiatus and in the differentiation of congenital shortening of the esophagus with hernia from paraesophageal hernia. The patient should be examined in the recumbent or the Trendelenburg position, as otherwise the hernia may be overlooked. If he swallows a few mouthfuls of a fairly thick suspension of barium sulfate while in an erect position and then a mouthful or more of the same mixture while lying down, a hernia, when present, will usually be detected and the type readily determined.

Direct visualization of the esophagus through an esophagoscope is also a useful procedure. In patients with congenital esophageal shortening with hernia, the junction of the esophagus and stomach is found at a higher level than normal. The presence of ulceration or stricture can be determined, and differentiation can be made from obstruction due to a malignant neoplasm. As the esophagoscope is passed through the area of spasm or stricture at the junction of the esophagus and stomach, gastric mucosa can be seen directly ahead of the examining tube even before the instrument enters the hernial sac if the hernia is of the short esophageal type. In a person with a normal esophagus or with cardiospasm or paraesophageal hernia, the esophagus inclines toward the left and anteriorly, so that the gastric mucosa is not seen until the tube has actually been introduced into the stomach.

Operative treatment is the procedure of choice for the paraesophageal type of hernia. For congenital shortening of the esophagus with hernia and for paraesophageal hernias in which dysphagia is a prominent symptom or in which operation is refused or deemed inadvisable, passage of dilating sounds over a previously swallowed silk thread is recommended.

THE DIGESTIVE SYSTEM

Emptying Time of the Normal Human Stomach in the Young Adult. Edward J. Van Liere and David W. Northup. Gastroenterology **1:** 279–284, March 1943.

The gastric emptying time was determined fluoroscopically in 69 healthy adult males between the ages of 20 and 30 years. The subjects were given the test meal at about 8:30 in the morning, having eaten nothing since the previous evening, and were instructed to relax both mentally and physically as much as possible. The meal consisted of 15 gm. of Quaker Farina boiled in 350 c.c. of water until the volume was reduced to 200 c.c. Fifty grams of barium sulfate were added.

The average gastric emptying time for the 69 young adults was 2.13 hours, the median 2.08 hours, and the mode 2.09 hours. The extremes ranged from 1.50 to 3.30 hours.

Peptic Ulcer at Fort George G. Meade, Md. Charles A. Flood. War Medicine **3:** 160–170, February 1943.

Seventy-five soldiers with peptic ulcer (71 duodenal, 4 gastric) at Fort George G. Meade were studied with

a view (*a*) to determining whether the digestive symptoms which persisted after treatment were due to an actual delay in the healing of the ulcer or were on a functional basis; (*b*) to discovering the underlying mechanism for failure of these patients to respond to treatment as they would in civilian life.

All of the patients were hospitalized. Only one-third were relieved of their symptoms within the first two weeks of treatment. Approximately one-half continued to have some gastric symptoms even after four weeks in the hospital, and the average period of hospitalization was two months. This is in notable contrast to a series of 225 civilian patients with duodenal ulcer with symptoms severe enough to require hospitalization, reported by St. John and Flood (Ann. Surg. **110:** 37, 1939); two-thirds of this group obtained complete symptomatic relief within two weeks.

In the present series the diagnosis of ulcer was established mainly by roentgen examination. A second roentgen study after two to four weeks served to estimate the degree of response to therapy and to confirm the original diagnosis in cases in which evidence of a deformity of the duodenal cap persisted even after healing of the lesion. Three of the patients with gastric ulcer were re-examined twice. In each instance the ulcer crater was found to be of approximately the same size as on the original examination, which was interpreted as indicating a considerable delay in the healing of simple gastric ulcer.

Ulcer craters in the duodenal bulb were demonstrated in 25 of 61 patients examined shortly after admission to the hospital. Of the 25 patients with demonstrable crater, 14 were re-examined after two to three weeks of treatment and 7 of these still showed a crater, indicating that improvement had not taken place. More than half of those patients in whom the roentgen evidence of ulcer activity consisted entirely in a duodenal deformity, with associated tenderness, irritability, and spasm, showed little or no improvement after two to three weeks.

Five patients in whom a diagnosis of duodenal ulcer was made on the basis of the first roentgen examination failed to have the diagnosis confirmed when the studies were repeated. This discrepancy in the roentgen findings emphasizes the desirability of a confirmatory examination before a final diagnosis is made, especially before discharging a soldier from the Army with a certificate of disability.

Six patients in the series showed only a duodenal deformity without any direct or indirect evidence of ulcer activity. All of these patients responded to treatment promptly.

Eleven patients were members of the regular Army. Symptoms subsided completely in less than a week in 7 of this group. Follow-up roentgen studies after treatment were carried out in 6 cases and showed notable improvement in all but 1 case.

Forty-seven patients were studied from the neuropsychiatric point of view. Twenty-five of these presented symptoms of an anxiety state or an anxiety neurosis. Fourteen continued to complain of symptoms after more than a month of treatment.

The author gives his suggestions for the management of patients with ulcer in station hospitals. From a military standpoint early classification for discharge or return to limited duty is the primary objective.

From this study the following conclusions are reached: (*a*) Most recent inductees with ulcer respond poorly to treatment, symptomatically and often roentgenologically as well. (*b*) In contrast to recent inductees, soldiers of the regular Army with many years of service, as a rule, respond well to treatment. They are usually of stable personality. (*c*) Delayed healing appears to be due in most cases to an associated anxiety state.

Diagnosis of Perforated Ulcer. Two Useful Maneuvers by Means of Which Pneumoperitoneum and Diaphragmatic Irritation Are Demonstrated More Clearly. Alexander E. Pearce. Am. J. Surg. **61:** 76–78, July 1943.

The occurrence of shoulder pain as a result of diaphragmatic irritation and its exact localization, as well as the obliteration of hepatic dullness, afford valuable evidence of perforated peptic ulcer. The author describes two maneuvers for the demonstration of pneumoperitoneum and diaphragmatic irritation. With the patient supine on the x-ray table in the usual manner, a Trendelenburg position of at least 25 degrees is instituted. When there is free fluid, it flows toward the diaphragm and the patient may complain spontaneously of referred phrenic nerve pain. If there is no complaint of pain, the patient should be questioned by the examiner regarding it. Cutaneous hypersensitivity in the shoulder regions should be noted; also hepatic dullness to percussion. After several minutes, the tilt of the table is reversed, so that the head is elevated about twenty-five degrees. A small sandbag is placed beneath the right scapular angle. In this position, the gas lies anterior to the liver. Obliteration of hepatic dullness can be determined more easily because the space anterior to the right lobe of the liver represents the highest portion of the peritoneal cavity, and the gas collects there. For radiography, the head is elevated further (as close to 90 degrees as possible) so that the highest peritoneal pocket lies above the liver.

Gastric Diverticula. Martin L. Tracey. Gastroenterology **1:** 518–531, May 1943.

Five cases of gastric diverticula are presented with a brief analysis of the findings in 35 cases. The symptoms in these cases were many and varied; only 4, or possibly 5, patients had symptoms that may have been attributable to the diverticulum. Associated with the diverticulum, 7 patients had duodenal ulcer, 3 carcinoma of the stomach, 2 gallstones, and 2 diverticula of the colon.

The following procedure is suggested for the diagnosis of gastric diverticulum. The stomach is carefully aspirated of fasting residue, if a gastric analysis does not precede the roentgenologic examination, and a small amount of barium or rugar, which is a rapidly spreading mixture of barium in mineral oil, is administered. The first swallow is often most important. One should be satisfied that the rugal pattern of the stomach is normal throughout, and a filled lumen will often hide outpouchings on the posterior wall. Change of position from the erect to the prone or supine is necessary to outline the cardiac area and fundus. This technic will usually reveal flecks, filling defects, or distortions of the usual mucosal pattern as well.

A diverticulum will fill out as a circumscribed, smooth pouch with little or no disturbance of normal mucosal pattern. It may not, however, fill in all positions, or may at times be prevented from filling by a fold of over-

lying tissue occluding its entrance. Films should be scrutinized for a localized, well rounded pocket of air near the gastric borders, as this may be the only roentgen finding.

Gastroscopic examination has confirmed the diagnosis and demonstrated the opening in several cases. It affords little information in a typical lesion at the cardia, and in this inaccessible area there is the possibility of perforating a diverticulum with a wide opening. During the performance of gastroscopy a surgeon capable of operating in case of a catastrophe should be within call.

Because surgery is obviously hazardous, it should be considered only if symptoms can be ascribed to the diverticulum, if obstructive symptoms intervene, if uncontrollable ulceration or neoplastic tissue within the diverticulum is suspected, or if medical treatment has failed.

Duration of Gastric Cancer. Walter Lincoln Palmer. Gastroenterology **1:** 723–736, August 1943.

The inaccessibility of the stomach to direct examination makes the study of gastric cancer difficult. It is recognized, however, that this tumor, like other neoplasms, varies enormously in its rate of growth. The author presents a number of cases, ranging from the "acute" rapidly metastasizing tumor of the Jarcho type, causing death from widespread metastases in fourteen or fifteen months after the first appearance of minor symptoms, to "chronic" neoplasms. One patient studied gastroscopically and roentgenologically for four years was found at operation to have a carcinoma which was still small and without evident metastases. The "acute" and "chronic" cancers seem to be quite different, biologically, yet the basis for their difference is not clear. The "acute" neoplasms tend to be infiltrative and totally undifferentiated histologically; the "chronic" tumors tend to be circumscribed, polypoid, and histologically highly differentiated. The consensus of opinion is that the degree of cellular differentiation is the most important single prognostic factor.

The differentiation of the biologic behavior of the various gastric tumors is not a simple matter. Microscopically, in some cases, the cells are structurally undifferentiated but highly differentiated functionally. Of the patients in the series studied, 50.2 per cent of those with a tumor classification (Broder's) of Grades 1 and 2, 22.8 per cent with Grade 3, and 14.9 per cent with Grade 4, survived ten years. The rate of growth of gastric carcinoma probably depends primarily upon the growth potential of the cell, for which there is no satisfactory measure or criterion except the general knowledge that as a rule the degree of malignancy is inversely proportional to the degree of differentiation.

The author concludes that with present criteria it is hazardous to estimate the prognosis and that, as a rule, all gastric carcinomata should be resected unless there exist proved distant metastases.

Chronic, Non-Specific Jejunitis with Unusual Features. Walter R. Johnson. Gastroenterology **1:** 347–353, April 1943.

A case of chronic non-specific jejunitis of unusual interest is reported. A 58-year-old Negro complained of intermittent attacks of indigestion for six years, characterized by epigastric fullness and bloating immediately after meals. At the time of one of the episodes, he had passed a large quantity of dark red blood from the bowel, but bleeding was never noticed at any other time. Chronic constipation was present until five weeks before the patient was seen by the author; at that time diarrhea with from four to eight daily movements made its appearance. The patient became progressively weaker and lost about 40 pounds in weight.

A small, tender, freely movable mass, the size of an olive, was discovered in the left lower quadrant of the abdomen, where it could be maneuvered between the bulge of the lumbar spine and the palpating hand. A slight degree of anemia was present. No free hydrochloric acid was detected in the gastric contents.

Roentgenoscopic examination revealed an essentially normal stomach. The duodenum was dilated and contained gas. Several short segments of the upper jejunum were also enlarged and were found to contain both gas and barium. At the six-hour study these segments of jejunum still contained a large amount of barium, but only a trace remained in the stomach. Some contrast medium was found in the cecum and lower ileum, which appeared negative.

At operation a loop of grossly dilated jejunum was encountered, encircled by napkin-ring-like masses of tumor tissue, 1/2 to 3/4 in. wide. The peritoneal surface was grayish in color and covered with tags of fibrin. Some of the mesenteric nodes draining the involved areas of gut were enlarged and firm. The uppermost lesion was 3 inches below the reflection of the jejunum at the muscle of Treitz. A second napkin-ring obstruction was found perhaps 5 inches distally, and the gut between was hugely dilated and filled with secretion. At intervals of from 6 to 12 inches, five additional napkin-ring lesions were found in the upper jejunum. The entire involved area was resected. The pathologic diagnosis was chronic non-specific regional jejunitis.

This case differs from those reported by Crohn (J. A. M. A. **99:** 1323, 1932). According to his observations, the disease almost invariably begins in the distal ileum and progresses proximally; obstructive phenomena are rare, and accumulation of barium in dilated upper jejunal loops does not occur. From the case reported here, it would seem the disease process may begin in the upper jejunum; progress distally; produce symptoms of obstruction; cause delayed passage of barium through dilated loops of upper jejunum, and finally remain localized to such a short segment that resection of the entire area is possible.

In his discussion of this paper, Doctor Crohn presented a case with similar findings, reported to him by Dr. Harold N. Brewster, of China.

Nonmeckelian Diverticula of the Jejunum and Ileum. Raymond E. Benson, Claude F. Dixon, and John M. Waugh. Ann. Surg. **118:** 377–393, September 1943.

One hundred and twenty-two cases of nonmeckelian diverticula of the jejunum and ileum seen at the Mayo Clinic from 1909 to 1942, inclusive, are reviewed. In 100 of this series the jejunum was involved; in 17 the diverticula were limited to the ileum, and in 5 they were scattered throughout the small intestine. The proximal portion of the jejunum was most frequently affected. The majority of the diverticula were situated along the mesentery. The size varied, the average being 1 to 4 cm. in diameter. In 44 of the 122 cases only one diverticulum was observed (37 in the je-

junum; 7 in the ileum); in each of 12 cases two diverticula were present, and in the remaining 66 cases, there were three or more. Diverticula of other viscera were found in 49 of the 85 patients in this series coming to necropsy. In only one of these 85 cases were the small intestinal diverticula considered to be the probable primary cause of death.

In the majority of this series, as indicated above, the diverticula were found at necropsy; in 21 they were discovered during the course of abdominal operation, and in 16 on roentgenographic examination of the small intestine. Diagnosis by roentgenoscopic and roentgenographic examination is comparatively easy (Weber, H. M.: J. A. M. A. **113**:1541–1546, Oct. 21, 1939).

Uncomplicated diverticulosis of the small intestine does not give rise to any characteristic symptoms. Symptoms referable to the diverticula appear with the occurrence of complications. In 13 of the 122 cases constituting this series, complicating conditions attributable to, or associated with, the diverticula were observed. The known complications of, or associated with, diverticula of the jejunum and ileum are: (1) acute mechanical obstruction, (2) chronic obstruction, (3) inflammatory disturbances, (4) hemorrhage, (5) rupture of diverticulum, (6) foreign bodies, (7) neoplasms, benign or malignant. Eleven cases with unusual and interesting complications are presented in detail.

Carcinoid Tumors (So-Called) of the Ileum: Report of Thirteen Cases in Which There Was Metastasis. Malcolm B. Dockerty and Frank S. Ashburn. Arch. Surg. **47**: 221–246, September 1943.

The author studied the small bowel tumors recorded in the files of the Mayo Clinic from 1906 to 1943. Among a total of some 130, there were 30 carcinoids, and of these 13 showed undoubted evidence of metastasis. The 13 case histories are reported at some length. The youngest patient was 39, the oldest 78, with an average age of 58; 8 were men and 5 women. Evidence of disturbed intestinal function was present in 9 of the cases; in 8 this consisted in symptoms of mild but progressive obstruction. In 6 patients abdominal masses could be palpated. Melena was observed only once, in contrast to other types of small bowel tumor. In 3 cases no gastro-intestinal symptoms were present. Laboratory findings were not characteristic. Roentgen study with barium was not always advisable clinically; in the cases examined acute buckling or kinking of the bowel was a common finding, and this the authors believe is characteristic.

Eleven cases were surgical problems; in 3 only a biopsy was done, because of the extent of the disease, and in another only a biopsy and short-circuiting operation. In 5 a one-stage resection, and in 2 a two-stage resection was done. Eight patients remained alive and well from ten months to fourteen years; 2 lived two and five years, respectively, and 1 died postoperatively. These results are particularly surprising in view of the known presence of metastases.

Pathologically the neoplasms tended to be in the terminal ileum as small, orange, submucosal nodules with minimal ulceration. In half the cases the tumors were multicentric. Involvement of the regional nodes was observed in all 11 instances, and hepatic metastases were present in 5. The microscopic picture was that of a very low-grade adenocarcinoma. Both this and the power of dissemination shown by these tumors should lead one to consider them malignant.

LEWIS G. JACOBS, M.D.

Appendiculocolic Fistula. Case Report. Louis P. River and Billens C. Gradinger. Am. J. Surg. **61**: 297–299, August 1943.

The authors present a case of appendiculocolic fistula, presumably due to intracolic rupture of an appendiceal abscess.

A colored solider, age 24, gave a history of repeated attacks of abdominal cramps. Physical examination was negative except for tenderness on deep pressure over the right lower quadrant. Gastro-intestinal x-ray studies showed continued spasm in the cecal region and the presence of a small residual mottled density at the mesial aspect of the ascending colon slightly above the level of the transverse process of the fifth lumbar vertebra. As the patient continued to complain, the x-ray studies were repeated a month later. Considerable spasm was present in the freely movable cecum, and it was difficult to make it fill well. The small mottled density seen previously appeared to be the wall of the colon, medial to a constantly unfilled area, and near what was thought to be the tip of a well filled, upward and medially directed appendix. At operation, a small, movable retroperitoneal mass was felt at the location of the mottled density. Only after the cecum was well mobilized was the appendix seen. It was then found to extend upward 2.5 cm. from its base, joining a rounded mass, 2.0 cm. wide by 1.5 cm. long, this latter joining the ascending colon 5 cm. above the base of the appendix. The mass was of doughy consistency and its contents were expressed into the colon. From the mesial aspect of this adventitious structure a long, slightly thickened appendix extended downward and laterally toward the tip of the cecum.

Appendiceal Lithiasis. Antonio M. Tripodi and Alfred L. Kruger. Am. J. Surg. **61**: 138–142, July 1943.

A case of appendiceal calculus, diagnosed preoperatively is reported. A 33-year-old soldier complained of a 20-pound weight loss and a poor appetite. Examination revealed only slight tenderness in the right lower quadrant. A scout film, as well as a flat plate of the abdomen with the stomach filled with barium, showed a round, laminated, opaque shadow, measuring about 2 cm. in diameter, in the right lower quadrant, suggesting a gallstone in the terminal ileum. On the six-hour film, it was seen that the calculus was definitely not in the ileum and it appeared as if the appendix, which was filled with barium in its proximal portion, extended into the stone. On fluoroscopy, the cecum, appendix, and calculus were seen to be freely movable, and it was then believed that the shadow represented an appendiceal calculus. Gallbladder studies were normal. Appendectomy was carried out and a stone, 2.5 cm. in diameter, was found in the appendix.

The author points out the importance of distinguishing between fecaliths and appendiceal calculi. The former are of frequent occurrence. The latter are rare. When appendiceal calculus is definitely diagnosed, surgery is indicated, as a superimposed acute inflammatory process with perforation may occur.

Solitary Neurogenic Sarcoma of the Mesentery. Review of the Literature and Report of a Case. Morris J. Shapiro and Moris Horwitz. Am. J. Surg. **61:** 132–135, July 1943.

A solitary neurogenic sarcoma of the mesentery is reported. The patient, a 62-year-old man, was first seen approximately three and a half months before an exploratory laparotomy was performed. During this period he lost 35 pounds in weight and had a septic temperature, up to 103° daily. There was a mass in the abdomen extending about 4 cm. above, below, and to the right of the umbilicus. Preoperative roentgenograms revealed a large irregular accumulation of barium in the right lumbar region, having the appearance of an encapsulated cavity associated with the small intestine through perforation. A diagnosis of a cystic tumor communicating with the intestine was made and confirmed at operation, when a large solitary neurogenic sarcoma was found in the mesentery of the jejunum. Exploration revealed no metastases. The tumor was successfully removed, but the patient died twenty-one months later of metastatic involvement.

Diagnostic Roentgenology in Gastroenterology for the Year 1941. Frank J. Rigos and B. R. Kirklin. Gastroenterology **1:** 669–686, July 1943.

A Review of the Gastro-Enterologic Diagnostic Roentgenologic Literature for the Year 1942. Frank J. Rigos and B. R. Kirklin. Gastroenterology **1:** 942–960, October 1943.

As the titles indicate, these are reviews of diagnostic roentgenology in the field of gastroenterology for 1941 and 1942. The bibliographies would be of more value if the titles of the articles were included, although their omission is in accord with the policy of the journal.

THE BILIARY TRACT

Primary Liver-Cell Carcinoma in Infancy. Report of Two Cases, One Showing Calcification. Wray J. Tomlinson and Ernst Wolff. Am. J. Clin. Path. **12:** 321–327, June 1942.

Two cases are reported of primary liver-cell carcinoma in infancy. In each instance the patient—a child of 18 months—was admitted to the hospital because of enlargement of the abdomen.

In the first case roentgen examination revealed an enlarged liver with scattered areas of calcification within the right lobe. The bony framework was within normal limits. Both lung fields showed small areas of partial calcification. No x-ray therapy was given. The patient died eleven days after admission to the hospital. Necropsy showed a tremendously enlarged liver, studded throughout with tumors measuring from 1.5 to 11.0 cm. in diameter, varying from a light blue-green to a dark brown-green color, with soft, necrotic areas. No regional or distant lymph node metastases could be demonstrated, but there was a small circumscribed tumor in a dilated vein in the apex of the left lung. The diagnosis was "primary liver-cell carcinoma (hepatocarcinoma); anemic necrosis with calcification; embolic tumor, left lung." It was thought that the calcification occurred in areas subjected to anemic necrosis due to tumor growth; there was no evidence of a teratoid hepatoma in this case. Of the 82 cases of primary liver-cell carcinoma occurring in children under 16 years of age which have been reported and found acceptable, only one other case showed calcification without teratoid aspects.

X-ray examination of the other child showed the stomach displaced far to the left and posteriorly by a large upper abdominal mass interpreted as the liver, with enlargement of both right and left lobes. A clinical diagnosis of carcinoma of the liver was made and high-voltage roentgen therapy was given (total dosage not stated). Death occurred approximately thirty-eight days after admission to the hospital. Autopsy revealed a primary liver-cell carcinoma (hepatocarcinoma), extending to the right kidney and adrenal and through the diaphragm to involve the mediastinum. X-ray therapy had not produced any significant necrosis of the cells or evidence of degeneration.

THE ADRENAL GLANDS

Cushing's Syndrome in Children. Review of the Literature and Report of a Case. Jason E. Farber, Francis J. Gustina, and Anthony V. Postoloff. Am. J. Dis. Child. **65:** 593–603, April 1943.

While it is generally believed that Cushing's syndrome rarely occurs in children, the authors were able to collect from the literature 26 cases of the disease with onset before the age of 16. They review these, presenting the outstanding features in a table, and report an additional case.

A white boy aged 15 years was admitted to the Meyer Memorial Hospital (Buffalo, N. Y.) on April 2, 1941, complaining of generalized weakness and a severe persistent backache. His symptoms began in July 1940, with a rapidly acquired obesity, mild general malaise, and fatigue after moderate exertion. In November 1940 he suffered mild frequency of urination with nocturia. He also had frequent sore throats, blurring of vision, and occasional frontal headaches. In January 1941, edema of the feet was observed on several occasions.

The boy's history of growth, development, and illnesses was not remarkable, although he was considered mentally retarded. On admission he was moderately dyspneic and was unable to sit up because of his extreme general weakness, as well as the pain associated with motion. The obesity was confined to the face, neck, and trunk. The height was 170 cm., weight 62.5 kg. The face was florid, greasy, and hairy, and there were a few small areas of telangiectasia. Examination of the visual fields showed some mild peripheral contraction, more evident in the right eye; examination of the eyes was otherwise normal. The blood pressure was 184/112. The external genitals were large but otherwise normal in appearance. There was considerable tenderness on pressure over the lumbar vertebrae. On the lateral and anterior surfaces of the thighs and flanks, and to a lesser extent on the legs, were many purplish striae. Neurologic examination was non-contributory except for revealing sluggish patellar and Achilles reflexes. Laboratory studies showed a decreased tolerance for sugar, hypoproteinemia, and hypochloremia.

X-ray examination revealed slight enlargement of the heart. The entire osseous system, especially the skull and spine, showed severe osteoporosis. The skull had a ground-glass appearance; the sella turcica was of normal size. All of the lumbar vertebrae showed narrowing of the bodies due to expansion of the nucleus pulposus.

The patient's condition became progressively worse. He became more dyspneic; his face grew more florid and obese; penile erections became impossible. No benefit was derived from roentgen irradiation of the pituitary body. Blood pressure varied from 190 to 156 systolic and from 142 to 112 diastolic. Examination of the eyegrounds on July 21 showed evidence of prolonged papilledema with absence of disk margins and with many surrounding old hemorrhages and exudates and a few areas of retinitis proliferans. The visual fields showed beginning bitemporal hemianopsia.

Retrograde pyelograms strongly suggested the possibility of a tumor in the region of the upper pole of the right kidney, extrinsic to the organ. Perirenal pneumoroentgenograms outlined a large adrenal tumor. A roentgenogram of the chest at this time showed scattered areas of pulmonary infiltration suggesting metastases. In spite of this, it was deemed advisable to remove the tumor, which proved to be an adrenal cortical carcinoma. Death occurred the day following operation. At autopsy tumor metastases were found in the lungs, kidneys, and veins.

THE SKELETAL SYSTEM

Symphalangism, a Familial Malformation. Paul Freud and Lawrence B. Slobody. Am. J. Dis. Child. **65:** 550–557, April 1943.

Symphalangism is defined as hereditary aplasia or hypoplasia of the interphalangeal joints and is believed to follow a simple dominant mendelian type of transmission. A family tree which covers four generations is presented. Nine of 10 members of the family were known to have symphalangism. Four of these cases, in a girl of 18 months and her three brothers, are described in detail and illustrated. The family at first glance was thought to be Negro, but one of the progenitors was found to be an American Indian, who married a negress. All previously reported examples have been in the white race. Symphalangism is often accompanied by other congenital malformations, such as syndactyly, brachydactyly, pes planus, and absence of the pectoralis muscles.

There may be complete or partial lack of development of the interphalangeal joint, and any or all of the four extremities may be affected. Usually one person will exhibit various degrees of symphalangism in different fingers. The proximal joints are commonly involved and the distal ones rarely. The thumbs are almost never affected, and the fifth fingers infrequently. When the interphalangeal joint is entirely absent, there is no dividing line between the two phalanges. With slight development of the joint, there are two distinct bones and two bone marrow cavities; motion is impossible. When development has progressed a little further, some bending and stretching become possible. The stiffened parts of the fingers and toes have a column-like appearance, and the covering skin is smooth, with none of the folds normally produced by action of the joints.

The differential diagnosis between ankylosis of the finger joint and symphalangism is simple. Symphalangism is present from birth. Several fingers are affected, the segment is extended, and the proximal joints are usually involved. Ankylosis is acquired; the segment is usually flexed, and the distal joints are involved.

Roentgenograms are presented, demonstrating the manner in which the various stages of articular differentiation occur during the life of the embryo. The earliest change is a constriction of the phalangeal beam. This progresses until only a central bony bridge remains. This bridging becomes less distinct and then invisible, and finally a normal joint space is formed. The process may cease at any point before complete differentiation, with resulting symphalangism.

Roentgenologic Aspects of Ewing's Tumor of Bone Marrow. Paul C. Swenson. Am. J. Roentgenol. **50:** 343–353, September 1943.

Twenty-six cases of Ewing's tumor, histologically proved and with fairly complete clinical and laboratory data, form the basis of this paper. The pathology and histogenesis of the tumor, as determined from a study of these and 16 additional cases, are the subject of an immediately preceding paper in the same journal (pp. 334–342) by Stout. Swenson merely points out that the histogenesis of the tumor is still disputed. Its cellular composition varies and because of this there are those who consider it a variant of reticulum sarcoma rather than a tumor having its origin "from vascular endothelium."

Of the 26 patients, the youngest was four years of age and the oldest was seventy-nine, the majority of cases falling in the period between ten and thirty years. Eleven patients were females and fifteen males. The initial lesions occurred most frequently in the humerus, ribs, femur, and ilium, in that order. Extraosseous involvement was almost an invariable finding. Metastasis to the lungs is a common terminal episode; also to the brain and other viscera.

Although the roentgenogram may reveal involvement of only a portion of the shaft of a long bone, pathologic specimens usually show that the disease has extended much further along the center of the bone than was apparent roentgenographically. Therefore, it is well to assume that the entire shaft may be involved. Because of the non-osseous origin of the tumor, only reactive or non-tumor bone is produced. This may be subperiosteal, in which case it is usually described as characteristically deposited in onion skin-like layers, or it may be intracortical. It was the author's experience that bone lysis was usually the predominant finding. Few of the tumors in the series studied resembled each other except that their malignant nature was apparent.

The histopathologic picture of the 26 cases varied. The impression was that the tumor always arises in the marrow. In most of the cases there seemed to be a definite expansion of the cortex. No estimate, of course, can be made of the amount of marrow involvement. Although there will be suggestive roentgenographic and clinical features in these tumors, biopsy will have to be the deciding factor in all.

As suggested above, it should be assumed for the purpose of roentgen therapy that the entire shaft of a long bone is involved. The lesion should be cross-fired from as many angles as necessary, in an attempt to get a maximum dose of about 4,500 r into the tumor. It is believed that a combination of surgery and roentgen therapy, when possible, will probably give the best results.

Numerous roentgenograms are reproduced and details of the 26 cases are tabulated.

CLARENCE E. WEAVER, M.D.

Eosinophilic Granuloma of the Tibia: Case Report. Thomas Horwitz. Am. J. Roentgenol. **50:** 355–357, September 1943.

Eosinophilic granuloma of bone presents itself as a well localized lesion that begins in the medullary cavity and expands, eroding and even perforating the cortex at the site of the lesion. It occurs in children and young adults. There is a history of painful, localized, and rapidly increasing swelling of only a few weeks' duration, with roentgen evidence of a rarefied and destructive lesion involving one or more bones (calvarium, ribs, or long bones). There is not infrequently an eosinophilia. Other clinical laboratory findings are normal.

Microscopically, the non-osseous material is composed of a cellular stroma, densely infiltrated by large aggregates of eosinophilic polymorphonuclear leukocytes. Although areas of focal necrosis may be observed, there are none of the usual evidences of bacterial inflammation or suppuration.

A case is reported involving the tibia of a 12-year-old boy. There was no evidence, roentgenologically, of lesions elsewhere in the skeleton. A mild eosinophilia was present. The immediate results following excision appeared to be good.

Attention is especially directed to the specific histopathologic features of this lesion that are unlike those of any classified disease of bone. Excision, with or without roentgen therapy, appears to lead to local relief of symptoms without local recurrence of the growth. CLARENCE E. WEAVER, M.D.

Osteitis Fibrosa Cystica: Differential Diagnosis, with Note on Repair of Maxillary Lesion by Cartilaginous Isograft. Noah Fox and Vito Taglia. Arch. Otolaryng. **37:** 377–390, March 1943.

The roentgen findings which characterize the various conditions that resemble osteitis fibrosa cystica (polyostotic fibrous dysplasia, osteitis fibrosa, osteitis deformans, bone metastases, osteomalacia, osteogenesis imperfecta tarda, etc.) are discussed. In osteitis fibrosa cystica the changes are those of a coarsely granular osteoporosis due to the loss of calcium, with replacement by fibrous or cystic tissue, with deformities of the bones due to collapse of supporting structures. The long bones present a broadening or expansion with a thinning of the cortex where cysts are present. The texture of the bones appears rarefied and trabeculated. Between the cystic areas, the bone shadows are diminished in density.

The authors report a case of osteitis fibrosa cystica in a woman, aged 35, who presented the characteristic roentgen and pathologic picture, a high calcium and a low phosphorus level in the blood, a negative calcium balance, and a parathyroid tumor. Removal of the tumor resulted in a return of the calcium and phosphorus levels, as well as of the calcium balance, to normal. A cyst in the face was curetted and filled with a cartilaginous isograft, restoring the normal facial contour.

Von Recklinghausen's Neurofibromatosis. N. V. Storr and P. Keen. South African M. J. **17:** 269–271, Sept. 11, 1943.

Two unusual cases of neurofibromatosis with hypertrophy of bone are presented.

One patient was a 12-year-old Zulu boy complaining of pain in the right leg. Examination showed the right femur, fibula, and tibia to be longer than the left and revealed numerous subcutaneous nodules, especially in the right buttock, and pigmentary changes in the skin. The first evidence of abnormality occurred at the age of 2 years, when the patient's right ankle began to swell. Blood calcium and phosphorus were normal, but the phosphatase was elevated to 10.4 units. Roentgen examination showed hypertrophy of the right half of the sacrum and right ilium, cystic changes in the epiphysis of the greater trochanter and acetabulum, and arthritic changes in the right knee and hip joints. Increase in width of the medulla was noted in the shafts of both femora and tibiae.

The second case was that of a 30-year-old native having generalized cutaneous and subcutaneous nodules present since childhood. These were painless, with the exception of those on the right wrist, which had been the seat of occasional severe pain. X-ray examination showed a typical Madelung's deformity with arthritic changes in the right wrist. Total excision of the tumors on the forearm was attempted but profuse bleeding permitted removal of only a portion.

The diagnosis was established in both cases by biopsy.

Five additional instances of von Recklinghausen's disease were found in the literature that were considered to show true bone hypertrophy. Other bone changes are more frequent. These include: (1) irregularity of periosteum and cortical structure; (2) cystic formation which appears radiologically similar to osteitis fibrosa cystica and occurs most frequently in the skull and spine, producing scoliosis; (3) atrophy of bone as a result of epiphyseal destruction by direct extension of the tumor; (4) osteomalacia with deformity due to tumor invasion of bone.

All seven reported instances of bone hypertrophy had an associated pachydermatocele (an elephantiasic condition of the dermis covering the neurofibromata). The hypertrophy is believed to be secondary to the intense hyperemia of this lesion overlying an epiphysis.

The authors include a general discussion of neurofibromatosis and discuss the ectodermic and mesodermic theories of the tumor origin. No effective treatment is known. Excision of the tumor may be of aid in relieving local symptoms. The authors believe heredity to be an important factor in this condition and suggest termination of pregnancy to prevent exacerbations and sterilization to eradicate the disease.

The bone changes associated with neurofibromatosis are not to be confused with osteitis fibrosa cystica, also known as von Recklinghausen's disease.

LESTER M. J. FREEDMAN, M.D.

Improved Technic for Blind Nailing of the Neck of the Femur. The Crecca-Cetrulo Guide. William D. Crecca and Gerald I. Cetrulo. Am. J. Surg. **61:** 93–98, July 1943.

The authors present a guide for insertion of a Steinmann pin in fracture of the neck of the femur, based on fixed anatomical landmarks, assuring tridimensional accuracy, as revealed in anteroposterior and lateral planes. The landmarks essential for the proper application of the guide are: (1) anterosuperior spine; (2) spine of the pubis and symphysis pubis; (3) the inferior border (ridge) of the lateral aspect of the greater trochanter. This method eliminates opening of the hip joint, avoids possible injury to vessels, insures accuracy of reduction and fixation, and shortens the operating time.

The technic is described in detail, with photographs and roentgenograms illustrating its application.

Disabling Changes in the Hands Resembling Scleroderma Following Myocardial Infarction. Alf C. Johnson. Ann. Int. Med. **19:** 433–456, September 1943.

Trophic changes in the hands resembling the scleroderma and sclerodactylia developing in Raynaud's disease were observed in 39 patients suffering from myocardial infarction. These came from a group of 178 cases of myocardial infarction in a series of 375 patients with grossly evident heart disease. No painful disability of the hands of this nature was observed unless myocardial infarction had occurred. The diagnosis of infarction was made on the basis of a typical clinical picture and electrocardiographic studies.

The first symptoms referable to the hands appeared three to sixteen weeks after the occurrence of the myocardial infarction and consisted in pain and stiffness of the fingers. There was uniform, firm bilateral swelling of the hands, and the skin appeared smooth and tight. Color changes, varying from an erythema to cyanosis occurred, and the hands were cold to the touch. The skin, which was at first thin and glossy, later became thickened and dull, as the swelling subsided. Pain and stiffness continued and atrophy of the soft tissues overlying the phalanges resulted in prominence of the metacarpals and tendons. In some cases roentgenograms showed disuse atrophy of bone. Initial shoulder pain occurred in 27 cases, but this the authors do not consider related to the hand changes.

In summarizing the status of the patients when last seen, the author states that all but 4 had atrophy of some degree; all but 2 had some limitation of motion of the fingers; 22 had contracture of the palmar fascia, and 22 had residual shoulder stiffness.

While the incidence of changes in the hands is high in this series—21.8 per cent of 178 patients with myocardial infarction—the author believes that it would be found to be equally high in comparable studies if allowance were made for certain factors. Thus, some patients do not survive the myocardial lesion long enough for the syndrome to develop; mild changes in the hands may be overshadowed by the cardiac symptoms; many cases are classified as rheumatoid or atrophic arthritis; follow-up data in myocardial infarction are not always available.

The disabling changes in the hands associated with myocardial infarction may be mistaken for those of rheumatoid arthritis, but actually the clinical features are distinctive. The changes are limited to the hands and are strikingly uniform, involving the entire hand and not simply the joints, as is so often the case in arthritis. Stiffness rather than pain is the prominent feature in the later stages, and the entire hand is held rigidly with the fingers semiflexed. Ulnar deviation and subcutaneous nodules so characteristic of rheumatoid arthritis do not occur. Contractions of the palmar aponeurosis of various degrees are common in the syndrome and unusual in rheumatoid arthritis. Finally, the syndrome occurs usually after middle life in patients with severe cardiovascular disease and has a tendency to recession, in contrast to rheumatoid arthritis, which begins usually before middle life in patients without cardiovascular disease, and has a strong tendency to progression and extension.

It is suggested that the cause of post-infarction sclerodactylia (which is offered as a convenient and rational name for this syndrome) is anoxia of the tissues of the fingers, produced chiefly by ischemia resulting from reflex vasoconstriction of the arteries of the hand induced by cardiac pain, and that the lesser effects of sclerosis of these arteries and the local anoxemia of the fingers which is part of the general anoxemia resulting from myocardial injury may increase the degree of the damaging tissue anoxia.

Four cases are reported in detail, with pertinent photographs, roentgenograms, and electrocardiograms. Data on the remaining cases are presented in tabular form.

In an addendum the author refers to Kehl's report on Dupuytren's contracture as a sequel to coronary artery disease and myocardial infarction (Ann. Int. Med. **19:** 213, 1943. Abst. in Radiology **42:** 311, 1944).

STEPHEN N. TAGER, M.D.

THE GENITO-URINARY TRACT

Traumatic Rupture of the Kidney. Payson Adams. Am. J. Surg. **61:** 316–323, September 1943.

The normal kidney may be ruptured by force exerted either from the front, side, or back, by a blow, fall, or crushing force. Renal injuries may be classified into three main groups: contusions, with or without subcapsular hematoma; fracture, complete or incomplete; and tears of the renal vessels.

Examination of a patient with kidney injury usually demonstrates severe tenderness in the costovertebral angle, side, and upper abdomen; if perinephritic hematoma is present, a mass may be palpated in the region of the kidney. Shock may occur immediately after the injury or may develop several hours later from hemorrhage. Hematuria is present in 90 per cent of the cases, though obviously it is absent when the ureter has been severed or when the renal vessels have been ruptured and the kidney spared from injury, or when the fracture line does not enter the renal pelvis. If blood clots block the ureter, hematuria disappears.

X-ray examination of the abdomen is often disappointing because the renal areas are obscured by intestinal distention, impossible or inadvisable to relieve with enemas, cathartics, or drugs. It is, however, of considerable value in revealing associated injuries, such as skeletal fractures, air under the diaphragm diagnostic of a ruptured viscus, or multiple intestinal fluid levels, suggestive of ileus. Excretory urography is the most valuable single accessory aid in determining the actual extent of renal damage. Retrograde urography is thought to be unnecessary and undesirable except when additional information is essential.

The author stresses early operation, after primary shock from trauma to the nerve plexus about the kidney pedicle is controlled and before secondary shock from hemorrhage occurs. Seven cases of severely ruptured kidney are analyzed.

Radiopaque Membranous Pyelitis Following Sulfonamide Therapy. Payson Adams. J. A. M. A. **122:** 419–423, June 12, 1943.

The author reports two cases in which a calcareous radiopaque membrane formed on the epithelial surfaces of the calices and renal pelvis of a kidney partially or completely blocked by a small ureteral calculus. This occurred shortly after administration of sulfathiazole in one case and sulfadiazine in the other. The membrane and kidney were available for study in one case; in the other only the membrane, which passed spontaneously.

Sulfathiazole and sulfadiazine should not be given indiscriminately to patients known to have associated ureteral stasis, pyelonephritis, and alkaline urine, as in such cases they may cause the rapid formation of a non-soluble, calcareous, radiopaque membrane. Preventive measures are correction of ureteral stasis, maintaining renal drainage, improving renal output, and rendering the urine highly acid.

Early operative removal of such membranes is not indicated, as separation from the pelvis and calices is difficult if not impossible at this time. Later the membranes may separate spontaneously and pass without operation, or at least they may be more easily removed at operation.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

Perinephric Abscess in Infants and Children. A Study of Twenty-Six Patients Surgically Treated. Henry Swan. Am. J. Surg. **61:** 3–10, July 1943.

Twenty-six proved and 6 possible cases of perinephric abscess, all occurring in children under thirteen years of age, are presented. The author classifies the lesions on an etiologic basis as metastatic (secondary to a distant focus), complicated by underlying renal disease, and secondary to trauma to the kidney. In this series, 11 cases were in the first group, 14 in the second, and 1 in the third.

The symptomatology of perinephric abscess in children differs little, if any, from that in adults. The site of the pain is varied and frequently fails to suggest the perinephrium as the site of disease. The type of abscess, whether metastatic, complicated, or traumatic, may usually be diagnosed from the history, an antecedent infection suggesting the metastatic type of lesion, while a history which includes urinary complaints or the finding of albumin or white cells in the urine is indicative of a complicated type of lesion. A "limp," due to irritation of the psoas muscle by the overlying inflammatory process, is a frequent complaint and may give an erroneous impression of hip-joint disease.

Intravenous pyelography should be included in the preoperative study of every patient suspected of having perinephric abscess unless the patient is so ill that the procedure is contraindicated. This will give confirmatory evidence in establishing the diagnosis, will demonstrate underlying renal abnormalities in those patients with the complicated type of lesion, and will establish the presence and gross functional status of the contralateral kidney.

For metastatic or traumatic perinephric abscess, early incision and drainage constitute the treatment of choice. In abscess complicating urinary disease, therapy must be individualized, consisting in immediate treatment of the perinephric abscess and the subsequent treatment of the underlying urinary tract lesion. Cystoscopy and retrograde pyelography, when the condition of the patient permits, give valuable information on the status of the urinary tract and the treatment indicated.

COMPLICATIONS

An Unusual Complication of the Intraspinal Use of Iodized Oil. Paul C. Bucy and Irving J. Speigel. J. A. M. A. **122:** 367–369, June 5, 1943.

The authors point out that, in most of the few reports of permanent undesirable effects following the intraspinal use of iodized oil, the final proof that the effects were directly due to the oil has not passed the most critical analysis without question. They record the case of a 36-year-old man with spondylolisthesis for which the lumbosacral spine had been fused in April 1937. About a year later lipiodol myelography was done because of the development of left sciatica. Fluoroscopy revealed that some of the oil lodged at the level of the eighth dorsal vertebra and remained there permanently. Late in 1941 progressive symptoms of involvement of the spinal cord at that level developed. Almost complete spinal block was found on lumbar puncture in February 1942. At operation, on March 10, 1942, two collections of encysted iodized oil in the subarachnoid space and a very thickened arachnoid membrane were found and removed. Nearly complete recovery followed in a few weeks.

It is concluded that in this case the presence of a preexistent localized adhesive arachnoiditis caused some of the iodized oil to become trapped at that point. The iodized oil in turn stimulated fibroblastic proliferation in the leptomeninx, thus increasing the arachnoiditis and resulting in dysfunction of the spinal cord.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

RADIOTHERAPY

NEOPLASMS

Malignant Tumors of the Middle Ear and the Mastoid Process. Frederick A. Figi and Bert E. Hempstead. Arch. Otolaryng. **37:** 149–168, February 1943.

Thirty-eight cases of cancer involving the middle ear and the mastoid process are reported: 25 were intrinsic, originating in the middle ear or mastoid process; 13 were extrinsic, originating in the pinna or in the structures adjacent to it.

The symptoms most commonly complained of are pain, discharge from the ear, ulceration in or about the ear, and decreased hearing on the affected side. The clinical findings vary greatly depending on the origin of the neoplasm, subjective symptoms being out of all proportion to the physical findings. Tumors developing intrinsically may reveal little evidence of their presence until well advanced. Frequently the external canal is filled with polyps, which are recurrent and may be fairly fibrous. A highly vascular, readily bleeding mass or a granular growth may be present in the canal or the canal may be narrowed by a diffuse thickening or infiltration of its walls. In extrinsic cancer, the clinical findings are likely to be pronounced and in a high percentage of cases a diagnosis of epithelioma can readily be made.

Roentgenograms of the mastoid process should be made in all cases of chronic infection of the ear and in those cases where there is a possibility of cancer. This is particularly true in cases of an intrinsic lesion, since in these the roentgenograms will frequently furnish valuable information. Roentgenographic studies are also essential in cases of extrinsic tumor extending into the external auditory canal or fixed to the mastoid

process. Although roentgenograms at times fail to reveal early involvement of the bone by a neoplasm, they often are of aid in determining the extent of the process if invasion of the bone is present. Among the 25 cases in this series in which the cancerous process arose within the mastoid cavity or middle ear or deep in the external auditory canal, the roentgenograms revealed evidence of pathologic change in the mastoid process in 21. Destruction of bone was evident in 8 cases, cloudiness in 7, sclerosis in 7, and a postoperative defect in 4. Among the cases of extrinsic cancer, roentgenograms were positive in 9; destruction of bone was shown in 6 cases and cloudiness in 5; in 4 cases some cloudiness of the mastoid cavity was present, but destruction of bone could not be discerned.

The authors have found the wide removal of the accessible portion of the neoplasm by means of electrocoagulation—either the coagulating or the cutting current or both—a definite improvement over excision. After thorough surgical removal of the neoplasm, radium points or tubes are placed directly in the operative cavity and a fairly caustic dose is given. If removal of the tumor appears to have been clean, points containing 1 mg. each of radium element encased in platinum usually are employed, from ten to fifteen of these being held in place by means of iodoform gauze, which keeps them well removed from the bone itself. These points remain in the wound for from twenty to thirty hours, a total dose of 300 to 400 mg. hr. being administered. A few days after operation, this treatment is supplemented with radium packs, an additional dose of from 4,000 to 18,000 mg. hr. being given. In cases in which the tumor is found to be highly malignant and the involvement so extensive that complete surgical removal appears impracticable, no attempt at complete surgical exenteration is made; radium points or tubes are immediately implanted directly into the growth, and the wound either is sutured loosely or a gauze pack is inserted to hold the radium in place. Considerable necrosis of bone usually results from electrocoagulation and irradiation, and removal of the resultant sequestrum, after separation, is required.

The authors summarize the results obtained in their series of 38 cases. Twenty patients lived two years or more after treatment, 15 three years or more, 10 seven years or more, 8 eight years or more, 3 more than ten years, and 1 fifteen years. Two patients could not be traced.

End Results of Treatment of Malignant Lesions of the Nasopharynx. Gordon B. New and Walter Stevenson. Arch. Otolaryng. **38:** 205–209, September, 1943.

A follow-up study was made of 271 patients treated prior to 1937 for malignant tumors originating in the nasopharynx. A biopsy revealed evidence of a malignant process except in 37 cases; in these cases the subsequent course of the disease confirmed the clinical diagnosis. Of the 234 histologically proved cases, 184 were squamous-cell carcinoma, 7 adenocarcinoma, and 43 sarcoma. Almost two-thirds of the treated patients were between 30 and 59 years of age. The average age of all the patients treated was 43.3 years.

All cases were treated by irradiation. The radium was introduced into the nasopharynx by means of a lead T applicator. The cross piece of the T, in the form of a trough, carried the radium directly against the tumor. Supplementary external radium or roentgen irradiation was employed in every instance. Fractional doses of roentgen rays were used in some cases. The patients returned every six weeks or two months for observation, and further therapy, directed into the nasopharynx or given externally, was carried out as indicated.

Of the patients who had sarcoma, 26.8 per cent were alive five years after treatment; and of patients who had squamous-cell epithelioma, 8.9 per cent were alive. Of the total number of patients who had malignant lesions, 13 per cent were living after five years. Twice as many patients with squamous-cell carcinoma were alive in the group without involvement of the lymph nodes at the time of treatment as in the group with such involvement.

Lymphoepithelioma of the Nasopharynx. Report of a Case. A. H. Persky. Arch. Otolaryng. **37:** 813–818, June 1943.

A case of lymphoepithelioma of the tonsil and nasopharynx is reported.

A woman, aged 52, was admitted to the hospital on July 17, 1940, complaining of a lump on her neck. This was first noticed thirty years before and had become progressively larger, until on admission it was the size of an orange. The growth was always symptomless, freely movable and painless, and moved up and down with swallowing. Examination showed the right tonsil to be greatly hypertrophied, extending beyond the mid-line, upward above the level of the soft palate, and downward along the carotid artery. It was rather firm, and on the mesial surface was a small superficial ulceration. On the right side was a palpable, painless submaxillary lymph node.

On July 24, the right tonsil was removed. The mass was well encapsulated and was enucleated from the fossa readily, leaving no residual tissue. There was no evidence of extension of the growth along the large vessels of the neck, nor were the cervical nodes palpable. The pathologic diagnosis was not conclusive, but the condition was thought to be an early Hodgkin's disease or a lymphoepithelioma.

On June 9, 1941, the patient was again seen, complaining of nasal obstruction and a swelling along the right side of her neck. This swelling was first noticed four months earlier and had become gradually larger. Examination of the throat revealed no evidence of recurrence of the original tumor, but the entire chain of cervical lymph nodes was palpable and enlarged. Each node was discrete, freely movable, and painless. A tentative diagnosis of Hodgkin's disease was made. Before a biopsy could be performed, however, the patient suddenly began to expectorate blood, and the following day she vomited a large quantity of black blood. On examination the bleeding proved to come from a large, soft, well encapsulated mass high in the nasopharynx, well above the level of the soft palate. A biopsy suggested a diagnosis of Schmincke's tumor (lymphoepithelioma).

High-voltage roentgen therapy was given: fourteen daily treatments of 200 r each, directed to alternate sides. The bleeding stopped and the tumor regressed rapidly. On June 29, it was impossible to find any residual evidence of tumor tissue, and locally the condition was considered cured. Death occurred from coronary occlusion about six months after the second admission.

This case presents a number of interesting features—the occurrence of the growth in the tonsil; the belated

appearance of cervical adenopathy (probably metastatic); the tumor in the nasopharynx, which would have been unrecognized if it had not been for the profuse hemorrhages; and the prompt regression of this latter growth after the institution of high-voltage roentgen therapy.

The author discusses the possible correlation of the two pathologic processes—whether the nasopharyngeal growth was merely a recurrence or metastasis of the original tumor in the tonsil or whether there were two malignant growths occurring about a year apart. He seems to favor the latter view.

X-Ray Treatment of Diseases of the Larynx. Maurice Lenz. Ann. Otol., Rhin. & Laryng. **52:** 85–108, March 1943. Also in Tr. Am. Laryng. A. **64:** 206–237, 1942.

X-ray treatment is employed chiefly in three groups of laryngeal diseases, namely, chronic inflammation, benign tumors, and cancer.

Inflammatory tissue is more radiosensitive than the adjacent normal tissues, and the latter remain practically unaffected by the small doses necessary to inhibit the growth of the former. Benign tumors are less responsive to radiation than inflammations, and some are so radioresistant as to make x-ray therapy impractical. The treatment is more likely to be successful in hemangiomas and papillomas. Carcinoma of the larynx is usually more radioresistant than either of the first two groups. The x-ray dosage which is required to arrest the growth in most of these cases is close to the maximum tolerated by the normal tissues and produces sloughing of the irradiated epidermis and of the laryngeal and pharyngeal mucosa. Unless the dosage has been too intensive, however, healing follows soon after the slough has separated, leaving little or no clinical evidence of radiation damage of the normal tissues.

Inflammations: The inflammatory diseases of the larynx in which x-ray treatment has been carried out most often are tuberculosis, blastomycosis, and scleroma. The author quotes numerous authorities on dosage and results in these lesions but does not record any extensive personal experience.

Benign Tumors: A case of hemangioma in an infant of 8 months and one of multiple papillomas in a woman of 22 years are recorded. The dosage in the child was 1,000 r to each side of the larynx, 150 r being given daily to alternate fields, with a 5-cm. cone (200 kv., 25 ma., 50 cm. T.S.D., 0.5 mm. Cu + 1.0 mm. Al). Treatment was given from June 9 to June 25, 1941, and eleven months later there was no evidence of disease. In the older patient repeated attempts to remove the papillomas by a biting forceps had failed. Left and right laryngeal fields were exposed daily for 20 treatments of 100 r each (200 kv., 25 ma., 1.0 mm. Cu +1.0 mm. Al, 50 cm. T.S.D.). The treatments were given in August and September of 1937 and the papillomas disappeared promptly, with no recurrence until 1941, when a single small papilloma appeared on the right vocal cord. Follow-up studies on several similar cases suggest that x-ray treatment of multiple papillomata in adults is worth while. About 200 r to each right and left lateral laryngeal field, as given in the case quoted, is the dosage generally required.

Cancer: The greater part of this paper is devoted to laryngeal cancer. In the Radiotherapy Department of the Presbyterian Hospital, New York, from which the communication comes, the technical factors used are 200 kv., 25 ma., 1 to 2 mm. Cu or Thoraeus filter, plus 1 mm. Al, and a 6 × 8 or a 7-cm. circular field over each lateral surface of the larynx. Occasionally smaller or larger fields are used and rarely an anterior or posterior field is added, depending on the location and extent of the disease. Treatment is started with about 50 to 75 r to each side of the larynx. After a few days, depending on the laryngeal reaction, this is raised to 100 or 125 r per field. The treatment is continued for four to seven weeks up to a total of about 3,000 to 3,500 r to each side, depending upon the size of the field and the laryngeal reaction. At the height of the reaction, the epithelium of the irradiated mucosa sloughs off and the defect is covered by a pseudodiphtheritic membrane. The following table shows the results (as of January 1942) in 89 patients treated between 1932 and 1936. An analysis of these cases is included and several are reported in some detail.

Treatment	No. Treated	No. Clinically Free from Cancer, January 1942
X-ray treatment after total laryngectomy	14	4 (9 years)
X-ray treatment after partial laryngectomy	5	3
X-ray treatment only	70	13
Totals	89	20

Value of Post-Operative Radiotherapy in Carcinoma of the Breast. R. McWhirter. Edinburgh M. J. **50:** 193–207, April 1943.

A series of 1,879 cases of carcinoma of the breast is reviewed. The average age of the patients was 55.5 years. In order to evaluate the results of treatment, the cases are grouped according to the method of staging suggested by Doctor Ralston Paterson: In Stage I the growth is confined to breast. In Stage II there are palpable mobile nodes in the axilla. In Stage III the growth has extended beyond the corpus mammae, the skin is invaded or fixed over an area large in relation to the size of the breast, and the tumor is fixed to underlying muscle. Axillary nodes may or may not be palpable, but if present they must be mobile. In Stage IV there are fixation or matting of axillary nodes, indicating extension outside the capsule, complete fixation of tumor to chest wall, and metastases in supraclavicular nodes, in skin wide of the tumor, to the opposite breast, and to distant parts. In this series 30 per cent of the cases were in Stage I, 17 per cent in Stage II, 20 per cent in Stage III, and 21 per cent in Stage IV; 11 per cent were recurrent carcinomas, and 1 per cent were unstaged.

To show the effects produced by postoperative radiotherapy, two groups of patients are compared—those treated by operation alone and those treated by operation and a full course of radiotherapy (not less than 3,500 r in three weeks to the chest wall and to the whole length of the chain of nodes from axilla to supraclavicular region on the affected side). The cases in Stage IV, which could be given palliative treatment only, and the patients who died postoperatively are excluded. The author found that, if a patient remained free from recurrence of the tumor for a period of three years, she was likely to be alive at the end of five years, and the figures in this report are therefore

based on the shorter period. Symptom-free is used in the sense of indicating that the patient was symptom-free *for* three years, not merely at the end of that period.

Fifty-four per cent of the patients in Stage I who received radical surgery only were symptom-free for three years; 76 per cent of those who received surgery plus radiotherapy were symptom-free for the same length of time; in Stage II, 28 per cent of the patients who received radical surgery and 60 per cent of those who received surgery plus radiotherapy were symptom-free for three years; in Stage III 21 per cent of the patients who received radical surgery and 44 per cent of those who received surgery plus radiotherapy were symptom-free for three years.

Treatment of Carcinoma of the Cervix at Charity Hospital: Preliminary Report of End Results. Manuel Garcia and Leon J. Menville. New Orleans M. & S. J. **96:** 87–91, September 1943.

A three-year follow-up study of 226 patients with carcinoma of the cervix seen between April 1938 and August 1939 is presented as a preliminary report.

Treatment was by a combination of x-ray and radium irradiation whenever possible. It usually began with external roentgen therapy—1,600 to 2,000 r in air through each of six pelvic ports in a period of 24 days, using 200 kv., 0.5 mm. Cu plus 1.0 mm. Al filtration, and 50 cm. distance. In addition, many patients received 5,000 r or less pervaginally. Radium was applied approximately one month later, when 5,000 to 8,000 mg. hr. were given in four to eight days, about half in the cervical canal and half in the vaginal fornices.

Besides 192 primary cases, the series included 22 recurrences and 12 patients with clinically healed lesions who received prophylactic irradiation, but the results in these small groups are not considered significant. The absolute three-year survival rate for the primary cases (one received no treatment and is therefore omitted) is 37.7 per cent.

For a study of the prognostic significance of various factors, 12 other patients who rejected therapy or discontinued it after one or two visits are omitted, leaving 179 upon which the authors' conclusions are based. Of this number, 174 had squamous-cell carcinoma with a three-year survival rate of 41 per cent, and 5 had adenocarcinoma with a survival rate of 20 per cent. In the 44 septic cases, there was a 29 per cent survival, while in the 135 uninfected cases the survival rate was 43 per cent. Little difference was noted in the age groups. Nine patients had developed carcinoma in the cervical stump and showed 22 per cent survival, whereas the 170 patients having carcinoma in the intact uterus showed 41 per cent survival. Concerning these figures the authors say: The variations in the survival rates recorded are not statistically significant, and we have no evidence to indicate that the type of lesion, the histologic picture, the age of the patient, or the presence of infection definitely influences the outcome of treatment.

As in other series, the anatomic extent of the disease again proved the most reliable standard for prognosis. The survival rates were 81 per cent in Stage I, 60 per cent in Stage II, 33 per cent in Stage III, 6 per cent in Stage IV. The cases having lesions of the stump are not included in these statistics.

Results of series recorded by other authorities are quoted for comparison.

LESTER M. J. FREEDMAN, M.D.

Hemangioma of the Elbow Successfully Treated with Radium at an Early Age. Ira I. Kaplan. Am. J. Dis. Child. **65:** 785–787, May 1943.

As has been strongly emphasized by many therapeutists, the earlier in life hemangioma is treated, the more ready the response to irradiation, the better the cure, and the less the ultimate disfigurement. Treatment of birthmarks of this type has sometimes been postponed, however, because of the fear that radiation may cause injuries to growing bones, especially when radium is applied at the area of a joint. It is, indeed, true that growing bone is susceptible to radiation injury, but a study of the cases recorded in the literature discloses that all such injuries were the result of intensive irradiation for a neoplasm or for correction of asymmetry of the limbs. In the treatment of hemangiomas, only mild applications of small doses of radium are employed at long intervals and no intensive, persistent treatment is maintained over any one area. The effect is primarily on the vascular network forming the hemangioma. When properly administered, such radium emanations should be almost totally absorbed in the superficial tissues and should in no way affect the underlying growing bone.

A case is reported in which treatment was applied directly over the elbow joint, opposite the epiphysis. The patient was followed over a period of nine years, from ten weeks to nine years of age. A total of 655 mg. hr. of radium, with platinum filtration, was given over a period of eleven months. The lesion is completely healed; there is no impairment of articular function, nor any evidence of involvement of bone, impairment of epiphyseal growth, or discrepancy in the length of the bones of the two arms.

Multiple Primary Malignant Lesions. Two Case Reports. Heinrich L. Wehrbein and John J. Weber. Am. J. Surg. **61:** 143–147, July 1943.

Two cases are reported of multiple malignant lesions. One patient had a carcinoma of the stomach and a prostatic carcinoma; both tumors had metastasized. The other patient had a prostatic carcinoma and a rhabdomyosarcoma of the rectum.

The authors call attention to the relative frequency of multiple malignant tumors.

NON-NEOPLASTIC DISEASES

Roentgen Treatment of Acute Bursitis of the Shoulder. John H. Harris. Pennsylvania M. J. **46:** 683–684, April 1943.

The author advocates the employment of roentgen therapy in acute bursitis of the shoulder and reports the "most gratifying response" in 40 cases thus treated. Daily treatments are given for three or four days, 250 r in air per treatment. The kilovoltage employed is unimportant providing filtration is adequate. The author has used 200 kv.p. with 0.5 mm. Cu plus 1.0 mm. Al and 120 kv.p. with 5.0 mm. Al, with equally good results. A 10 × 10 cm. area is treated, with centering at the point of maximum tenderness. Care is taken to avoid the lung field.

Within twenty-four to thirty-six hours there is marked relief from pain, and by the end of the third day the severe pain has disappeared. There remains a stiffness which gradually subsides, and most patients are using the arm in a normal manner in a week to ten

days. The calcium is slowly absorbed, and in the cases re-examined it had completely disappeared in three to four months.

Erythroblastic Anaemia with Review of the Literature. James M. Flynn. Brit. J. Radiol. **16:** 157–165, June 1943.

Erythroblastic anemia (Cooley's anemia, von Jaksch's disease) is commonly seen in the children of Mediterranean races. Its occurrence in other races has never been proved. The cause is unknown.

The symptoms are pallor, enlarged spleen, progressive anemia, and icterus. The blood picture shows marked achromia and poikilocytosis. The red cells are resistant to hypotonic salt solution. Normoblasts are characteristically present.

The long bones have a thinned cortex with prominent trabeculae at the ends and increased porosity, some areas presenting a "punched-out" appearance. The skull changes are especially characteristic. There is increased thickness, particularly in the frontal and occipital regions. Striations appear perpendicular to and arising from the thin inner table.

No known treatment is of any avail. Splenectomy is indicated when the spleen is unduly enlarged, but this does not change the course of the disease. Authorities differ as to the value of irradiation. The preponderance of evidence is that it is unsuccessful.

One case is recorded and an excellent review of the literature is presented. Eighty-six references are appended.

SYDNEY J. HAWLEY, M.D.

EXPERIMENTAL STUDIES

Effect of X-Rays on Aqueous Solutions of Biologically Active Compounds. Walter M. Dale. Brit. J. Radiol. **16:** 171–172, June 1943.

On exposing solutions of crystalline carboxylpeptidase of various concentrations to different amounts of roentgen radiation, it was found that dilute solutions could be almost completely inactivated by small doses while concentrated solutions required proportionately much larger doses to produce the same effect. It was also found that the enzyme was not inactivated in the presence of its substrate and that this "protection phenomenon" was exerted by a number of other substances, as nucleic acid and various sugars. Sodium chloride, however, did not protect the enzyme from inactivation. Both the dilution and protection phenomenon held for organic biologically active substances other than enzymes, such as acetylcholine. Both phenomena and their quantitative relations may be understood by assuming that the radiation acts upon the solvent, forming an intermediate product, which then reacts with the solute.

These roentgen findings indicate that the biological effects of radiation are to be explained upon an indirect-action theory rather than a quantum-hit theory. The indirect-action theory accounts not only for the effects in simple solutions but also in complex systems. It explains adequately both the dilution effect and the protection effect and is applicable to conditions of irradiation of living tissue.

According to this theory the effect of x-rays on a given substance will depend on the specific affinity between it and the intermediate product, on the affinity of other substances present at the same time, on their relative concentrations, and on the physiologic action of these substances.

It is possible to correlate these findings on simple systems with some of the observed phenomena in more complex living matter. Thus, younger cells, more especially embryonic cells, and sprouted seeds are more sensitive than older cells and dry seeds, because of their greater water content (the dilution effect). The variation in radiosensitivity of a cell in certain phases may be explained by the operation of both dilution and protection effects, as local conditions in the protoplasm, which is not homogeneous, may permit changes in the activity of certain proteins after irradiation. This will also explain the graded "non-specific" response to irradiation and the great "specific" sensitivity under certain conditions. SYDNEY J. HAWLEY, M.D.

Response of Cells in Vitro to Variations in X-Ray Dosage. Ilse Lasnitzki. Brit. J. Radiol. **16:** 137–141, May 1943.

In experiments previously reported (Brit. J. Radiol. **16:** 61, 1943. Abst. in Radiology **41:** 526, 1943) doses of radiation ranging from 100 to 1,000 r to tissue cultures from the choroid and sclerotics of 9- to 11-day-old chick embryos produced temporary inhibition of mitosis with some degenerating cells.

In this study, carried out with the same tissue and dosages of 2,500 to 10,000 r (160 kv. constant potential, 1.2 mm. Al filter, 100 r per minute), breakdown of the cells occurred soon after irradiation; the greatest effect appearing at three hours. Cultures in which mitotic activity was reduced before irradiation responded in the same manner.

The author concludes that the time at which the degenerate cells appeared and the absence of mitotic recovery during the period of observation indicate that the degeneration seen after the doses employed in these experiments is due to a breakdown of cells in the resting stage. This is in contrast to the results following exposure to a dose range of 100 to 1,000 r, which indicated an effect on the dividing mechanism.

SYDNEY J. HAWLEY, M.D.

Some Results of the Photographic Estimation of Stray X Radiation Received by Hospital X-Ray Personnel. L. H. Clark and D. E. A. Jones. Brit. J. Radiol. **16:** 166–168, June 1943.

A method of determining the approximate dosage of stray radiation received by members of an x-ray staff, by carrying a dental film in a suitably designed holder, is described. Only a portion of the film is exposed. On the remainder of the film an exposure of known quantity and quality is made for comparison. While the method is not extremely accurate, it is convenient and errors are on the safe side. Two thousand tests in four different hospitals showed that the vast majority of workers were receiving less than 0.25 r per working day. SYDNEY J. HAWLEY, M.D.